A COMPARATIVE STUDY OF RATE OF RETRACTION AND MOLAR CONTROL BETWEEN DUAL DIMENSIONAL WIRES AND RECTANGULAR WIRES DURING RETRACTION, USING MINISCREWS

Dissertation Submitted to

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

For partial fulfillment of the requirements for the degree of

MASTER OF DENTAL SURGERY

BRANCH – V

ORTHODONTICS AND DENTOFACIAL ORTHOPAEDICS

THE TAMILNADU DR. M.G.R MEDICAL UNIVERSITY

CHENNAI – 600 032

2012 – 2015

ACKNOWLEDGEMENT

First of all, I seek the blessings of the **Almighty God** without whose benevolence; the study would not have been possible.

I take this opportunity to thank my parents Mrs.Padmini and Mr.Gnanesh, my Husband Dr.Nagesh D.M.,and my adorable kids Mas.Ruhann and Mas.ryann for their endless patience during the entire period of this three years of course.

It is my privilege and great honour to express my gratitude to my respected guide and **Principal Dr. SRIDHAR PREMKUMAR, M.D.S., Professor,**Department of Orthodontics and Dentofacial Orthopaedics, Tamilnadu Govt.Dental College and Hospital, Chennai-3, for his conceptualization,patience guidance, support and encouragement throughout the study and during the three years of course.

I express my deep sense of gratitude and honour to my respected **Professor and Head, Dr. G.Vimala M.D.S.,** Department of Orthodontics and Dentofacial Orthopaedics, Tamilnadu Govt. Dental College and Hospital, Chennai-3, for her constant inspiration and encouragement throughout the entire course.

I owe my thanks to **Dr.Balashanmugam,M.D.S.,Professor**, Department of Orthodontics and Dentofacial Orthopaedics, Tamilnadu Govt. Dental College and Hospital, Chennai-3, for helping me with his valuable suggestions and encouragement.

I owe my thanks to, **Dr.G.UshaRao, M.D.S., Dr.Vijaykanth MDS., Dr.M.D. Sofitha, M.D.S., Dr.K.Usha, M.D.S., Dr.D.Nagarajan, M.D.S., Dr.Mohammad Iqbal, M.D.S., Dr.Jayanthi,M.D.S. Associate and Assistant Professors,** Department of Orthodontics, Tamilnadu Government Dental College and Hospital, Chennai-3 for their support and encouragement.

I thank Dr.Mohammad Junaid**.,** for helping me with the Statistics in the study.

I offer my gratitude to my patients who expressed complete cooperation for the successful completion of this study

I take this opportunity to express my gratitude to my friends and colleagues for their valuable help and suggestions throughout this study.

TRIPARTITE AGREEMENT

This agreement herein after the "Agreement" is entered into on this day............... day of December 2014 between the Tamil Nadu Government Dental College and Hospital represented by its Principal having address at Tamilnadu Government Dental college and Hospital, Chennai-03, (hereafter referred to as the 'college'

And

Dr.SRIDHAR PREMKUMAR aged 47 years working as professor in the Department of Orthodontics and Dentofacial orthopaedics, at the college, having residence address at B-3, Block 2, Jains Ashraya Phase III, Arcot road,Virugambakkam, Chennai-92. (herein after referred to as the 'Principal investigator')

And

Dr.Sangeetha.M.G.aged 36 years currently studying **M.D.S (Orthodontics)** in Tamilnadu Government Dental college and Hospital (herein after referred to as the 'PG/Research student and co- investigator').

Whereas the 'PG/Research student as part of his curriculum undertakes to research on**.** "**A Comparative study of rate of retraction and molar control between Dual Dimensional wires and Rectangular wires during retraction, using Miniscrews"**for which purpose the PG/Principal investigator shall act as principal investigator and the college shall provide the requisite infrastructure based on availability and also provide facility to the PG/Research student as to the extent possible as a Co-investigator Whereas the parties, by this agreement have mutually agreed to the various issues including in particular the copyright and confidentiality issues that arise in this Regard. Now this agreement witnesseth as follows:

1. The parties agree that all the Research material and ownership therein shall become the vested right of the college, including in particular all the copyright in the literature including the study, research and all other related papers.
2. To the extent that the college has legal right to do go, shall grant to licence or assign the copyright do vested with it for medical and/or commercial usage of interested persons/entities subject to a reasonable terms/conditions including royalty as deemed by the college.
3. The royalty so received by the college shall be divided equally by all the parties.
4. The PG/Research student and PG/Principal Investigator shall under no circumstances deal with the copyright, Confidential information and know how generated during the course of research/study in any manner whatsoever, while shall sole vest with the manner whatsoever and for any purpose without the express written consent of the college.
5. All expenses pertaining to the research shall be decided upon by the principal investigator/Co-investigator or borne sole by the PG/research student(co-investigator).
6. The college shall provide all infrastructure and access facilities within and in other institutes to the extent possible. This includes patient interactions, introductory letters, recommendation letters and such other acts required in this regard.
7. The principal investigator shall suitably guide the student Research right from selection of the Research Topic and Area till its completion. However the selection and conduct of research, topic and area research by the student researcher under guidance from the principal investigator shall be subject to the prior approval, recommendations and comments of the Ethical Committee of the college constituted for this purpose.
8. It is agreed that as regards other aspects not covered under this agreement, but which pertain to the research undertaken by the student Researcher,under guidance from the Principal Investigator, the decision of the college shall be binding and final.

9. If any dispute arises as to the matters related or connected to this agreement herein, it shall be referred to arbitration in accordance with the provisions of the Arbitration and Conciliation Act, 1996.
10. In witness whereof the parties hereinabove mentioned have on this the day month and year herein above mentioned set their hands to this agreement in the presence of the following two witnesses.

College represented by its

Principal	**PG Student**

Witnesses	**Student Guide**

1.
2.

ABSTRACT

Introduction: Conventional rectangular wires used for retraction of anteriors in premolar extraction cases, causes increased resistance to sliding due to various factors like stiffness friction, binding etc., thereby increases the treatment time and also puts a strain on the molars due to the reciprocating forces of retraction. Dual Dimensional wire has been used in this study to reduce the resistance and allow easy sliding of the archwire during retraction, along with good control of molars with the help of miniscrews as direct anchorage.

Aim and Objectives: To study the rate of space closure and molar control between Dual Dimensional wire and Rectangular wire during retraction using miniscrews. To compare the rate of space closure and molar control between the above two wires.

Materials and Methods: Sixteen patients, chosen in the age group of 17-25,who fulfilled the inclusion and exclusion criteria were segregated as Group A and B, for Dual Dimensional wire and conventional Rectangular wire respectively. Models, Cephalograms were taken before and after the study period (4 months).Clinical procedure involved placing the microimplants and the wires in the respective groups followed by retraction with NiTi coil springs, attached between the implant head and S hook fixed mesial to canine. At the end of study period, results were analysed using SPSS software .

Results: The results showed significant difference in the amount of space closure between Dual Dimensional wire and rectangular group with 0.7 mm more in the

DDW group, in the given study period. The mean change in the amount of space closure was 4.01mm and 3.31 mm in DDW and Rectangular wire group respectively. Mesial tangent on the right molars showed marginal significance (0.049). Minor changes were observed in the position of molars in both the groups with more changes in the Rectangular wire, though the changes were statistically insignificant.

Conclusion: In the era of low friction systems and Microimplant, it becomes prudent to choose Dual Dimensional wire over conventional wire for smooth and easy sliding of archwire during retraction, when miniscrews act as anchorage provider, to control the molars, and hence faster tooth movement leading to reduced retraction time for space closure, in orthodontic treatments.

Keywords: Dual Dimensional wire, rectangular wire, NiTi coil spring, microscrews, hooks.

CONTENTS

LIST OF TABLES

14	Intra Group Comparision Of Group B- Model Analysis –Angular Measurement Of 1st Molar With Respect To Midline. Rotational Control
15	Difference Calculation -Group A Vs Group B-Cephalometric Measurements
16	Difference Calculation -Group A Vs Group B-Cephalometric Measurements –Rotational Control
17	Difference Calculation -Group A Vs Group B -Model Analysis - Space Closure
18	Difference Calculation -Group A Vs Group B -Model Analysis -Linear Measurement Between Midline To Canine,2nd Premolar And 1st Molar-Transverse Control
19	Model Analysis –Angular Measurement Of 1st Molar With Respect To Midline-Between The Groups Rotational Control.
20	Model Analysis Group A-Pre-Post Treatment -Incisive Papilla -1st Molar,2ndpremolar And Canine -Anteroposterior Control –Left Side.
21	Model Analysis Group A –Pre-Post Treatment -Incisive Papilla -1st Molar,2ndpremolar And Canine Anteroposterior Control- Right Side.
22	Model Analysis Group B –Pre-Post Treatment Model Analysis-Incisive Papilla -1st Molar,2ndpremolar And Canine - Anteroposterior Control- Right Side
23	Model Analysis Group B-Pre-Post Treatment -Incisive Papilla -1st Molar,2ndpremolar And Canine - Anteroposterior Control Left Side..

LIST OF CHARTS

LIST OF PHOTOPLATES

LIST OF ANNEXURES

ABBREVIATIONS

MESDIS	Mesiodistal measurement of extraction space in millimeters
LONGAXIS	Horizontal distance between the longaxis of 2nd premolar and canine in millimeters
PTV-6-	Horizontal distance between pt v to distal of 1st molar in millimeters
ANG SN 6-	Angle between sn plane and 1st molar in degrees
BA-N6,PM,M	Basion-nasion plane to 1st molar,2nd premolar and canine in degrees
SPACE 13-15	Space present between 13 and 15 in millimeters
SPACE 23-25	Space present between 23 and 25 in millimeters
MID C RT	Midline to right canine in millimeters
MID C LT	Midline to left canine in millimeters
MID PM RT	Midline to right premolar in millimeters
MID PM LT	Midline to left premolar in millimeters
MID M RT	Midline to right molar in millimeters
MID M LT	Midline to left molar in millimeters
M ANG DIS RT	Midline to right molar distal tangent in degrees
M ANG MES RT	Midline to right molar mesial tangent in degrees
M ANG DIS LT	Midline to right molar mesial tangent in degrees
M ANG MES LT	Midline to right molar distal tangent in degrees
I.P.-6	Anteroposterior distance from incisive papilla to the reference points drawn from the central pit of 1st molar in millimeters

I.P.-5	Anteroposterior distance from incisive papilla to the reference points drawn from the central pit of 2nd premolar in millimeters
I.P.-3	Anteroposterior distance from incisive papilla to the reference points drawn from the central pit of canine in millimeters.
I.P.	Incisive papilla Perpendicular
IOPA	Intra oral periapical radiographs
SPSS	Statistical Package for Social Sciences
MIA	Mini implant Anchorage
T 0	Pre-treatment
T1	Post-treatment
MBT	Mc laughlin Bennet Trevisi
DDW	Dual dimensional wire

INTRODUCTION

The success of any treatment lies in choosing the right materials and techniques, to bring forth the required changes when preserving the rest of the environment. It holds true for Orthodontic treatments too. It is preferable to achieve the required tooth movement with the rest of the teeth or occlusion unharmed. Of all the treatments done in Orthodontics, retraction of Proclined anterior teeth forms a very important and common procedure. Retraction can be simply defined as moving the teeth Posteriorly. It is done mainly by 1.Enmasse or 2. Two stage retraction (separate canine retraction).

Although the two steps procedure is predictable and has excellent fail-safe characteristics, it takes longer to close space in two steps than one. so, enmasse retraction is recommended[1.].To maximize the utility of the extraction space for retraction of anteriors, in premolar extraction cases it is essential to control the amount of incisor retraction vs. molar-premolar protraction. Preventing the posteriors from moving forward into the extraction space (Anchorage control)- is an essential part of treatment planning in Orthodontics.

The reasons for anchorage loss are excessive force, improper anchorage preparation, impingement of the roots of the incisors or anterior teeth to the labial cortical plate etc. The common methods to prevent anchorage loss are by using anchorage savers like 1. Tranpalatal arches, lingual arches, nance palatal arches.2.use of optimum force 3.usage of differential force4.reinforcemnt of anchorage and so on.

But Anchor loss is almost inevitable and is one of the major causes of prolonged treatment time and unsuccessful treatment outcome. One of the main reason for loss of molar control is the resistance and friction produced by the stiffer wires used during retraction. Rectangular wires are used for space closure, after alignment and leveling of comprehensive orthodontic treatment with sliding mechanics. One of the main disadvantage of these wires is that they generate reciprocating forces between the anterior and posterior teeth during retraction, when movement (mesial) of posteriors are unwanted. It is ideal to have retracting forces in the anterior section and mild forces or nil force in the posteriors .It takes more time to close the extraction space with these stiffer rectangular wires, as they resist easy sliding of the wire distally, due to various factors such as increased wire size ,friction requiring more force etc., which often results in anchor loss as well, leading to the loss of extraction space available, to be used for anterior retraction or correction. Conventional wisdom states that an orthodontist must apply added force to overcome friction, the result of which can be increased anchorage loading and subsequent anchorage loss.

If the teeth are free to slide along the archwire, friction between brackets and archwires does not increase anchorage loading. The ideal in the use of sliding mechanics would be to find the best combination of arch wire size, slot size, and force which would translate a tooth along an arch wire with minimal friction, without excessive tipping, and without unduly disturbing anchorage.

Introduction of Skeletal anchorage in Orthodontics by Creekmore, T. and Eklund, M.K[2], has become a boon as it has widened the horizon of orthodontic treatment mechanics. Miniscrews and Miniplates[3] offers the possibility of various tooth movements with reduced or minimum anchor loss and lesser need for patient compliance. Studies have proved that they provide excellent molar control. So, Miniscrew usage has become an important milestone in recent orthodontics.

This study was undertaken with the hypothesis that easy sliding of the archwire distally along with anterior torque control, during retraction produces effective teeth movement, if the retracting forces are from miniscrews, which allows us to have improved molar control as well, leading to the success of the treatment.

To achieve anterior torque control along with reduced resistance to sliding of the archwire,during space closure,bidimensional system[4] was introduced. Dual Dimensional wires[5] with two different dimensions were introduced as a Bidimensional system .These are Orthodontic wires with two different dimensions in the same continuous archwire. The anterior section is square or rectangular and posterior section is round.

This combination produces effective anterior retraction with minimal change in the position of posteriors, during space closure. With the conventional wires molar control is usually an issue but when miniscrews provide anchorage, these dual dimensional wires slide freely in the molar tube distally, because of the round cross section in the posterior region, allowing faster space closure with anterior torque control.

AIMS AND OBJECTIVES

AIM

To study and compare the rate of retraction and molar control between Dual Dimensional wires and Rectangular wires during retraction, using miniscrews.

OBJECTIVES

1. To study the rate of space closure, molar control during retraction ,using dual dimension wire (DDW)
2. To study the rate of space closure, molar control during retraction, using conventional rectangular wires.
3. To compare the rate of space closure, molar control during retraction, between DDW and conventional rectangular wires.

REVIEW OF LITERATURE

1. sliding mechanics and Anchor loss
2. Friction and Archwire
3. Retraction with Miniscrews
4. Bidimensional system
5. Dual Dimensional Wire

SLIDING MECHANICS

Charles CR.[6] (1982) explained that the most of the methods of canine retraction have their inherent advantages and disadvantages. The retraction systems which slide canines along a relatively rigid archwire, would appear to have the advantage of achieving better controlled apical and crown movement but at the obvious cost of greater friction and binding than the sectional arch.If sliding mechanics are used either with a J hook headgear to canines or elastic intra-traction from the molars, it would seem advisable to use a heavy round wire in at least a medium width bracket. To help decrease binding when using elastic traction, power arms would certainly seem to have a place, with the added benefit of patients having an accessible hook to change elastics themselves.

Ulgen M.[7] (1990) Space closure in frictional mechanics has usually been performed in two stages to avoid straining the anchorage teeth; however, this technique is usually more time-consuming than one-stage (en masse) retraction,' and it places more strain on anchorage than commonly recommended.

J.A.Von Fraunhofer and B.E.Johnson[8] (1993) in their article force generation by orthodontic coil springs, said that efficient, biological tooth movement by means of light continuous forces is the preferred treatment modality in contemporary orthodontics. Their findings indicated that the niti coil springs would deliver a relatively constant force over a range of 7 mm tooth movement with one activation and also that NITI coil springs appeared to be superior choice to consistently deliver light continuous forces while moving teeth and practical too.

Kusy RP [9](2000) said that the resistances to sliding (RS) were measured in vitro for various archwires against stainless steel brackets. Using stainless steel ligatures, a constant normal force (300g) was maintained while second-order angulation (straight theta) was varied from -12 degrees to +12 degrees. Using miniature bearings to simulate contiguous teeth, five experiments each were run in the dry or wet states with human saliva at 34 degrees C as a function of four archwire alloys, five interbracket distances, and two bracket engagements. Outcomes were objectively analyzed to establish when theta=0, and the relative contact angles (theta - r) were replotted. Stiffer archwires and shorter interbracket distances exacerbated binding, whereas, once corrected for differing bracket engagement, RS was independent of slot dimension.

Joon-No Rhee[10] (2001), his study was designed to explore the differences between friction and frictionless mechanics for maxillary canine retraction with the use of a new typodont simulation system, the Calorific machine system. The unit was designed to observe the whole process of tooth movement and is composed of 3 parts: a temperature regulating system, electrothermodynamic teeth, and an artificial alveolar bone component. The efficiency of maxillary canine retraction was compared with the sliding mechanics (along a .016 × .022–in stainless steel labial arch and nickel-titanium closed coil spring) and a canine retraction spring. The patterns of tooth movement obtained with both of these mechanics were measured 5 times each. Friction mechanics were superior to frictionless mechanics in terms of rotational control and dimensional maintenance of the arch ($P < .0001$); frictionless mechanics were shown to be more effective at reducing tipping and extrusion ($P < .0001$).

Tominaga[11] (2009) studied measures to determine optimal loading conditions such as height of retraction force on the power arm and its position on the archwire in sliding mechanics. A 3D finite element method (FEM) was used to simulate en masse anterior teeth retraction in sliding mechanics. The degree of labiolingual tipping of the maxillary central incisor was calculated when the retraction force was applied to different heights of a power arm set mesial or distal to the canine. Placement of the power arm of an archwire between the lateral incisor and canine enables orthodontists to maintain better control of the anterior teeth in sliding mechanics. Both the biomechanical principles associated with the tooth's center of resistance and the deformation of the archwire should be taken into consideration for predicting and planning orthodontic tooth movement.

Anchor loss and sliding mechanics.

Heo W[12] (2007) In their study to compare the amount of loss of anchorage, the maxillary posterior teeth and amount of retraction of the maxillary anterior teeth between en masse retraction and two-step retraction of the anterior teeth.30 female patients were chosen, who needed maximum posterior anchorage. The amount of horizontal retraction of the maxillary anterior teeth was not different between the two groups. Bodily and mesial movements of the upper molars occurred in both groups. Approximately 4 mm of the retraction of the upper incisal edges resulted from 1 mm of anchorage loss in the upper molars in both groups. They concluded that there were no significant differences existed in the degree of anchor loss of the upper posterior teeth and the amount of retraction of the upper anterior teeth associated with en masse retraction and two-tep retraction .

M Barlow and K Kula[13](2008) in their review article on Factors influencing efficiency of sliding mechanics to close extraction space explain that clinical research support laboratory results showed nickel-titanium coil springs produce a more consistent force and a faster rate of closure when compared with active ligatures as a method of force delivery to close extraction space along a continuous arch wire; however, elastomeric chain produces similar rates of closure when compared with nickel-titanium springs. Clinical and laboratory research suggest little advantage of 200 g nickel-titanium springs over 150 g springs.

Thiruvenkatachari B[14] (2008)et al The purposes of their study were to measure and compare the rates of canine retraction with titanium microimplant anchorage and conventional molar anchorage. The sample comprised of 12 patients (8 female, 4 male; mean age, 19.7 years; range, 16-22 years) who were scheduled for extraction of all first premolars. After leveling and aligning, titanium microimplants 1.2 mm in diameter and 9 mm in length were placed between the roots of the second premolar and the first molars. The implants were placed in the maxillary and mandibular arches on the same side in 10 patients and in the maxilla only in 2 patients. A brass wire guide and a periapical radiograph were used to determine the implant position. After 15 days, the implants and the molars were loaded with closed coil springs with a force of 100 g for canine retraction. Preretraction and postretraction lateral cephalograms were taken and superimposed for measuring the amount of retraction. The amount of canine retraction was measured from pterygoid vertical in the maxilla and SN perpendicular in the mandible. Mean canine retraction amounts were 4.29 mm in the maxilla and 4.10 mm in the mandible on the implant-anchorage side, and 3.79 mm in the maxilla and 3.75 mm in the mandible on the molar-anchorage side. The rates of canine retraction were 0.93 mm per month in the maxilla and 0.83 mm per month in the mandible on the implant-anchored side, and 0.81 mm per month in the maxilla and 0.76 mm per month in the mandible on the molar-anchored side.

Canine retraction proceeds at a faster rate when titanium microimplants are used for anchorage.

Yukio Kojimaa and Hisao Fukuib[15](2010) explained en-masse sliding mechanics have been typically used for space closure. Tipping of the anterior teeth occurred immediately after application of retraction forces. The force system then changed so that the teeth moved almost bodily, and friction occurred at the bracket-wire interface. Net force transferred to the anterior teeth was approximately one fourth of the applied force. The amount of the mesial force acting on the posterior teeth was the same as that acting on the anterior teeth.

Irrespective of the amount of friction, the ratio of movement distances between the posterior and anterior teeth was almost the same. By increasing the applied force or decreasing the frictional coefficient, the teeth moved rapidly, but the tipping angle of the anterior teeth increased because of the elastic deflection of the archwire. Finite element simulation clarified the tooth movement and the force system in en-masse sliding mechanics. Long-term tooth movement could not be predicted from the initial force system. The friction was not detrimental to the anchorage. Increasing the applied force or decreasing the friction for rapid tooth movement might result in tipping of the teeth.

Xu TM[16](2010) et al conducted a pilot randomized clinical trial to investigate the relative effectiveness of anchorage conservation of en-masse and 2-step retraction techniques during maximum anchorage treatment in patients with Angle Class I and Class II malocclusions. Sixty-four growing subjects (25 boys, 39 girls; 10.2-15.9 years old) who required maximum anchorage were randomized to 2 treatment techniques: en-masse retraction (n = 32) and 2-step retraction (n = 32); the groups were stratified by sex and starting age. All patients used headgear, and most had transpalatal appliances. Lateral cephalograms taken before treatment and at the end of treatment were used to evaluate treatment-associated changes. Differences in maxillary molar mesial displacement and maxillary incisor retraction were measured with the before and after treatment tracings superimposed on the anatomic best fit of the palatal structures. Differences in mesial displacement of the maxillary first molar were compared between the 2 treatment techniques, between sexes, and between different starting-age groups. Average mesial displacement of the maxillary first molar was slightly less in the en-masse group than in the 2-step group (mean, -0.36 mm; 95% CI, -1.42 to 0.71 mm). The average mesial displacement of the maxillary first molar for both treatment groups pooled (n = 63, because 1 patient was lost to follow-up) was 4.3 ± 2.1 mm (mean ± standard deviation). This finding appears to contradict the belief of many clinicians that 2-step canine retraction is more effective than en-masse retraction in preventing clinically meaningful anchorage loss.

Nayef H. Felemban[17](2013) explained that enmasse retraction of incisors has the advantage of eliminating friction, which is created during sliding of canines and, which usually contributes to loss of anchorage during space closure.Unlike, enmasse retraction, a disadvantage of segmental retraction method is the creation of unaesthetic spaces distal to lateral incisors, which persist for a considerably long time during treatment.

FRICTION AND ANCHOR LOSS

Bednar JR[18](1991) et al., conducted an in vitro study of simulated canine retraction to evaluate the difference in frictional resistance between stainless steel arch wires and steel and ceramic brackets with elastomeric, steel, and self-ligation. Each bracket slot was 0.018 x 0.025 inch. The arch wires used were 0.014-inch, 0.016-inch, 0.018-inch, 0.016 x 0.016-inch, and 0.016 x 0.22-inch stainless steel. The clinical significance of this study becomes apparent when stainless steel brackets are used on the posterior teeth and ceramic brackets are used on the anterior teeth. If sliding mechanics are used, the anterior teeth may be more resistant to movement than the posterior teeth because of the greater friction of the ceramic brackets. This could result in more posterior anchorage loss than would be expected if only one type of bracket were used.

Husain N, Kumar A[19](2011) The purpose of this investigation was to determine the kinetic frictional resistance offered by stainless steel and Titanium bracket used in combination with rectangular stainless steel wire during in vitro translatory displacement of brackets.In this study. Brackets: (All brackets used had a torque of - 7° and an angulation of 0°): (1) Dynalock (Unitek) 0.018" slot, 3.3 mm bracket width, (2) Mini Uni-Twin 0.018" slot, 1.6 mm bracket width, (3) Ultra-Minitrim 0.022" slot 3.3 mm bracket width, (4) Titanium 0.022" slot, 3.3 mm bracket width. Wires: (1) 0.016 x 0.022" stainless steel (2) 0.017 x 0.025"stainless steel (3) 0.018 x 0.025" stainless steel, elastomeric modules ,0. 009" stainless steel ligature wires, hooks made of 0.021 x 0.025" stainless steel wires, super glue to bond the hooks to the base of the bracket, acetone to condition the bracket and wires before testing and artificial saliva. Brackets were moved along the wire by means of an Instron universal testing machine (1101) and forces were measured by a load cell. All values were recorded in Newtons and then converted into gms (1N-102 gm). 200 gm was then subtracted from these values to find out the frictional force for each archwire/bracket combination. The results showed that narrow brackets generated more friction than wider brackets. Frictional force was directly proportional to wire dimension. Hence greater applied force is needed to move a tooth with a bracket archwire combination demonstrating high magnitudes of friction compared with one with a low frictional value.

Rajesh M[20].(2014) studied to evaluate the amount and percentage of anchor loss after initial leveling and aligning using a ROTH and MBT prescription. Pre and post alignment lateral cephalograms & dental casts of 10 ROTH & 10 MBT patients. In the study, it was found that the amount of anchor loss is greater in the ROTH group than the MBT group. This could be due to the increased anterior tip in the ROTH prescription, compared to MBT. The total anterior tip in ROTH is 270 and in MBT is 200. The additional tip of 70 in ROTH prescription itself would have resulted in forward thrust of the anteriors. The use of laceback and cinchbacks creates a statistically and clinically significant increase in the anchorage loss specifically when the posterior anchorage is not enhanced. In this study TPA was not used but studies have shown that passive TPA has almost no effect on the clinician's need to preserve anchorage in the correction of malocclusion. On the other hand, the TPA is an excellent way to prevent molar rotation and maintain the original vertical and transverse dimension when desired.

Frank CA, Nikolai RJ[21] 1980 Practitioners are aware of the presence of friction in those orthodontic appliances where relative motion between bracket system and arch wire occurs in ordinary deactivation processes.. The objective of this investigation was to evaluate and compare frictional forces generated in an experimental stimulation of the canine-retraction procedure on a continuous arch wire. Six independent variables were chosen for study: arch wire size and shape, bracket width and style, second-order angulation between bracket and passive arch wire, arch wire material, ligature force and type of ligation, and interbracket distances. Frictional resistance was found to be nonlinearly dependent upon bracket/arch wire angulation. With small and generally nonbinding angulations, bracket width and ligature force were the dominant influences on level of friction. As angulations were increased, producing binding between wire and bracket, this variable itself became the controlling parameter. Wire shape and arch wire stiffness in bending, a function of three of the variables studied, apparently exerted substantial influence on frictional-force magnitude at relatively high angulations.

Tidy[22](1989) explained that with brackets out of alignment, arch wire stiffness strongly influences forces normal to the points of contact and hence friction. In a well-aligned arch, forces that result from arch wire deflection are not important and friction is largely independent of arch wire stiffness. However, kinks or deposits along a closely fitting arch wire are more likely to lead to binding in the slot and clearance is therefore of some secondary importance. The component of friction caused by active torque may also be greater for a closely fitting wire because of its greater torsional stiffness and the reduced play between wire and slot. To reduce friction clinically, some practitioners prefer the use of round wire, or they reduce rectangular wire in the buccal segments to a more rounded cross section. Round wires, of course, eliminate friction caused by active torque. Round wires generally produce less friction than rectangular wire when engaged in brackets out of alignment because of their greater flexibility.

Dieter Drescheret al.[23](1989) explained that guiding a tooth along an arch wire will results in a counteracting frictional force. Clinically, a mesiodistally applied force must exceed the frictional force to produce a tooth movement. A friction-testing assembly simulating three-dimensional tooth rotations was constructed to study factors affecting friction magnitude. Five wire alloys (standard stainless steel, Hi-T stainless steel, Elgiloy blue, nitinol, and TMA) in five wire sizes (0.016, 0.016 × 0.022, 0.017 × 0.025, 0.018, and 0.018 × 0.025 inch) were examined with respect to three bracket widths (2.2, 3.3, and 4.2 mm) at four levels of retarding force (0, 1, 2, and 3 N). The following factors affected friction in decreasing order: retarding force (biologic resistance), surface roughness of wire, wire size (vertical dimension), bracket width, and elastic properties of wire. The effective force has to increase twofold to overcome the friction resulting in a hazardous overload of the anchorage units.

Sunil Kapila[24], et al.,(1990) investigated the effects of wire size and alloy on frictional force generated between bracket and wire during in vitro translatory displacement of bracket relative to wire. Stainless steel (SS), cobalt-chromium (Co-Cr), nickel-titanium (NiTi), and β-titanium (β-Ti) wires of several sizes were tested in narrow single (0.050-inch), medium twin (0.130-inch) and wide twin (0.180-inch) stainless steel brackets in both 0.018- and 0.022-inch slots. The wires were ligated into the brackets with elastomeric ligatures. Bracket movement along the wire was implemented by means of a mechanical testing instrument, and frictional forces were measured by a compression cell and recorded on an X-Y recorder. β-Ti and NiTi wires generated greater amounts of frictional forces than SS or Co-Cr wires did for most wire sizes. Increase in wire size generally resulted in increased bracket-wire friction. The wire size-alloy interaction on the magnitude of bracket-wire friction was statistically significant ($p < 0.005$).

Tselepis M[25], Brockhurst P, West VC. (1994) in their study quantifies the dynamic frictional force of sliding between different modern orthodontic brackets and arch wires. From the multitude of factors involved in the frictional process, the following were selected for investigation: arch wire material, bracket material, bracket-to-arch wire angulation, and lubrication (artificial saliva). The frictional force involved in sliding a ligated arch wire through a bracket slot was measured with a universal materials testing machine. A four-way analysis of variance was used to assess the results. Of the four factors investigated, all were found to have a significant influence on friction. Friction increased with bracket-to-arch wire angulation. Lubrication significantly reduced friction.The forces observed suggest that friction may be a significant influence on the amount of applied force required to move a tooth in the mouth. Hence, arch wire and bracket selection may be an important consideration when posterior anchorage is critical.

D.J. Michelberger[26], (2000) explained that Frictional resistance at the bracket-archwire interface has been demonstrated to impede tooth movement when sliding mechanics are used. They studied the coefficients of friction of titanium and stainless steel brackets in conjunction with stainless and ion-implanted beta-titanium archwires using a single contact interface between the brackets and archwires. .They concluded that round stainless steel wires demonstrated lower coefficients of kinetic friction than the flat stainless steel wire surfaces.

A Buzzoni R, Elias CN[27], (2011) explaind that low friction system is based on the free flow between the wire and the bracket slot. To assure this free flow between the wire and the bracket binding should be kept to a minimum. To permit free flow the clinician will choose an initial wire of round shape with a very small diameter. This difference in size between the wire and the lumen of the bracket leaves an empty space that will minimize binding. A small round shape wire will also minimize binding at the entrance and exit of the bracket. The partial engagement minimizes tipping of the teeth. The combination of small round wires and no binding exerts lower forces on the periodontal membrane of the teeth in the system. They introduced the “Biozone concept.” The Biozone is the area in the periodontal membrane where the vascular tissues bathe in collagen fibers, ideally in balance with the intra and extra vascular forces. The higher friction observed in rectangular wires can be explained by the greater contact, or greater likelihood of contact with the bracket slots, which affects the surface component that makes up friction forces. We will rarely observe friction values in rectangular wires that are lower than the round counterparts.

Dholakia[28] KD 2012 explain that friction is inevitable. To overcome this frictional resistance, excess force is required to retract the tooth along the archwire ie, individual retraction of canines, en masse retraction of anterior teeth, in addition to the amount of force required for tooth movement. The anterior tooth retraction force, in addition to excess force (to overcome friction), produces reciprocal protraction force on molars, thereby leading to increased anchorage loading. This article reinforce the fact that clinically, friction increases anchorage loading in all three planes of space, considering the fact that tooth movement is a quasistatic process rather than a purely continuous or static one, and that conventional ways of determining the effects of static or dynamic friction on anchorage load cannot be applied to clinical situations (which consist of anatomical resistance units and a complex muscular force system). better choice for long-term stability.

MICROIMPLANTS

Creekmore TD, Eklund MK[2](1983) The first clinical report in the literature of the use of TADs appeared in 1983 when Creekmore and Eklund used a vitallium bone screw to treat a patient with a deep impinging overbite. The screw was inserted in the anterior nasal spine to intrude and root and correct the upper incisors using an elastic from the screw to the incisors 10 days after the screw was placed.

Costa A[29], Raffainl M, Melsen B(1998) In this study,the problems related to anchorage for orthodontic tooth movements in patients with deficient dentition are discussed, and various solutions suggested in the literature, including "onplants," implants, and zygoma wires, are evaluated. A miniscrew is presented as alternative anchorage. Miniscrews are easily placed and removed and can be loaded immediately following insertion. However, stability is limited after loading with torsion.

In 2000, Park HS[30], in his study, a skeletal Class II patient was treated with sliding mechanics using M.I.A.(micro-implant anchorage)explained that the maxillary micro-implants provide anchorage for retraction of the upper anterior teeth.. The micro-implants remained firm and stable throughout treatment. This new approach to the treatment of skeletal class II malocclusion has the following characteristics: Independent of patient cooperation, shorter treatment time due to the simultaneous retraction of the six anterior teeth. Early change of facial profile motivating greater cooperation from patients These results indicate that the M.I.A. can be used as anchorage for orthodontic treatment. The use of M.I.A. with sliding mechanics in the treatment of skeletal Class II malocclusion increases the treatment simplicity and efficiency. ..

Hyo-Sang Park, Tae-Geon Kwon[31], (2004) concluded that Sliding mechanics with maxillary microscrew implants provide anchorage for bodily retraction with a slight intrusion by making the force pass near the center of resistance. The maxillary posterior teeth and anterior teeth can both be retracted without anchorage loss. When microscrew implants are used, clinicians can retract six anterior teeth altogether without anchorage loss even with the use of preadjusted appliances.

According to **Eric J. W. Liou,[32] ,a Betty C. J. Pai, and James C. Y. Lin, (2004),** Miniscrews provides stable anchorage for orthodontic tooth movement but do not remain absolutely stationary like an endosseous implant throughout orthodontic loading. They might move according to the orthodontic loading in some patients. To prevent hitting any vital organs because of miniscrew displacement, it is recommended that miniscrews be placed in a non–tooth bearing area that has no foramen, major nerves, or blood vessel pathways, or in a tooth-bearing area allowing a 2-mm safety clearance between the miniscrew and dental root.

Aldo Carano[33], Stefano Velo, (2005) demonstrated the versatility and technical advantages of skeletal anchorage.They explained the advantages of miniscrews over other forms of anchorage as, Optimal use of traction forces, regardless of the number or positions of the teeth, shorter treatment time, with no need to prepare dental anchorage, independence of patient cooperation, patient comfort, low cost.

Badri Thiruvenkatachari,[34] A. Pavithranand,b K. Rajasigamani,c and Hee Moon Kyungd (2006) The purpose of this study was to compare and measure the amount of anchorage loss with titanium microimplants and conventional molar anchorage during canine retraction. Subjects for this study comprised 10 orthodontic patients (7 women, 3 men) with a mean age of 19.6 years (range, 18 to 25 years), who had therapeutic extraction of all first premolars. After leveling and aligning, titanium microimplants 1.3 mm in diameter and 9 mm in length were placed between the roots of the second premolars and the first molars. After 15 days, the implants and the molars were loaded with closed-coil springs for canine retraction. Lateral cephalograms were taken before and after retraction, and the tracings were superimposed to assess anchorage loss. The amount of molar anchorage loss was measured from pterygoid vertical in the maxilla and sella-nasion perpendicular in the mandible.Mean anchorage losses were 1.60 mm in the maxilla and 1.70 mm in the mandible on the molar anchorage side; no anchorage loss occurred on the implant side. They concluded that Titanium microimplants can function as simple and efficient anchors for canine retraction when maximum anchorage is desired.

Hyo-Sang Park[35],a Seong-Hwa Jeong,b and Oh-Won Kwonc(2006) in their study on miniscrews found that miniscrews used as orthodontic anchorage should be loaded early to reduce treatment time and should be removed after treatment. In addition, microscrew implants are normally placed below or above the roots or between the roots of the teeth, or in the palatal or retromolar area, in dental implants, mobility due to lack of osseointegration is a sign of failure. For screw implants used as orthodontic anchorage, however, mobility might not represent failure. They checked the mobility of the screw implants 5 to 8 months after placement, during loading. Deguchi et al postulated that less osseointegration does not necessarily indicate a negative finding.. Therefore, minimal mobility can be allowed in orthodontic screw implants.

Neal D. Kravitza[36] and Budi Kusnotob(2007) described the risk factors with miniscrew placement. They said that nerve injury can occur during placement of miniscrews in the maxillary palatal slope, the mandibular buccal dentoalveolus, and the retromolar region. Peri-implant soft-tissue type, health, and thickness can affect stationary anchorage of the miniscrew. To account for potential migration, the clinician should allow a 2-mm safety clearance between theminiscrew and any anatomical structures.

Madhur Upadhyay[37], Sumit Yadav, and Sameer Patil (2008) did a caphalometric study to determine the efficiency of mini-implants as intraoral anchorage units for en-masse retraction of the 6 maxillary anterior teeth when the first premolars are extracted compared with conventional methods of anchorage reinforcement.The mini-implants placed in the interdental bone between the maxillary first molar and second premolar proved to be efficient for intraoral anchorage reinforcements for en-masse retraction and intrusion of the maxillary anterior teeth. They concluded that there was no anchorage loss with mini-implants in either horizontal (anteroposterior) or vertical direction compared with conventional methods of anchorage reinforcements. However, a decrease in intermolar width was noted. No significant differences were found in the rates of retraction between the 2 groups. A finite element analysis was done by Sang-jin sung,Gang-won jang to examine the effective en-masse retraction design with orthodontic mini- implant anchorage .Their results revealed that the height of the anterior retracton hook and the placement of the compensating curves had limited effects on the labial crown torque of the central incisors for enmasse retraction.For high mini-implant traction and 8 mm anterior retraction condition,the retraction force vector was applied above the center of resistance for the 6 anterior teeth,but no bodily retraction of the 6 anterior teeth occurred.

Shingo Kuroda[38], Kazuyo Yamada, Toru Deguchi, Hee-Moon Kyung, and Teruko Takano-Yamamotoe (2009) compared treatment outcomes of patients with severe skeletal Class II malocclusion treated using miniscrew anchorage or traditional orthodontic mechanics of headgear and transpalatal arch. Pretreatment and posttreatment lateral cephalograms were analyzed. The results showed , Both treatment methods, achieved acceptable results as indicated by the reduction of overjet and the improvement of facial profile. However, incisor retraction with miniscrew anchorage did not require patient cooperation to reinforce the anchorage and provided more significant improvement of the facial profile than traditional anchorage mechanics (headgear combined with transpalatal arch).They Concluded, Orthodontic treatment with miniscrew anchorage is simpler and more useful than that with traditional anchorage mechanics for patients with Class II malocclusion.

Basha AG[39], Shantaraj R, Mogegowda SB(2010) their study was conducted to measure and compare the difference between rate of en-masse retraction with molar anchorage and mini-implant.A comparative study consisting of 14 patients (all females) randomized into 2 groups. Seven in group I (nonimplant) molar was used as anchor for en-masse retraction of anterior teeth (mean age 16 years SD +/- 1.41). In group II (implant), mini-implant was used as anchorage to retract the anterior teeth (mean age 17.36 SD +/- 1.35). In both groups, all first premolars were extracted. After leveling and aligning, surgical steel mini-implant of 1.3 mm in diameter and 8 mm in length were placed between the roots of second premolar and first molar in the maxilla in the implant group. Implants were immediately loaded with 2 N of force. In nonimplant group molar was used as anchorage. The retraction and postretraction lateral cephalograms were taken. Rate of retraction and anchor loss were measured by using pterygoid vertical in maxilla. Student t test were used to analyze the treatment charges in 2 groups. Mean anchor loss in maxilla in nonimplant group. No differences in the mean rate of retraction time were noted in both groups.

Papadopoulos MA[40], Papageorgiou SN, Zogakis IP. 2011 Preliminary three-dimensional analysis of tooth movement and arch dimension change of the maxillary dentition in Class II division 1 malocclusion treated with first premolar extraction: conventional anchorage vs. mini-implant anchorage.

Jambi S[41], et al, (2014) The objective of their 3-arm parallel randomized clinical trial was to compare the effectiveness of temporary anchorage devices (TADs), Nance button palatal arches, and headgear for anchorage supplementation in the treatment of patients with malocclusions that required maximum anchorage. The study included 78 patients (ages, 12-18 years; mean age, 14.2 years) who needed maximum anchorage. The primary outcome was mesial molar movement during the period in which anchorage supplementation was required. The secondary outcomes were duration of anchorage reinforcement, number of treatment visits, number of casual and failed appointments, total treatment time, dento-occlusal change, and patients' perceptions of the method of anchorage supplementation. The randomization was based on a computer-generated pseudo-random code with random permuted blocks of randomly varying size. There was no difference in the effectiveness between the 3 groups in terms of anchorage support. There were more problems with the headgear and Nance buttons than with the TADs. The quality of treatment was better with TADs. As a result, TADS might be the preferred method for reinforcing orthodontic anchorage in patients who need maximum anchorage.

BIMETRIC SYSTEM

John C[42]. Bennett, Richard P. Mclaughlin, (1990) concluded in their study that archwire thinning is effective, but have discarded it because of reduced tooth control in the thinned areas. Selective torque application is more effective, especially in the incisor regions. Flat wires can be adjusted quickly and easily at chairside to carry a customized 10-15º of incisor torque. Likewise, molar torque can be selectively applied to resist mesial movement of the molars and create a basis for sound functional movements

Schudy[43], F.F. and Schudy, G.F(1975) introduced biometric system.

Giancotti[4], A. and Gianelly, (2001) A.A.: in their study explained three-dimensional control in extraction cases using a Bidimensional approach, the double section archwire resulted to be an effective alternative option to optimize the lateral and posterior sliding mechanics with controlled tipping and by the application of lighter forces.

Cannon JL[44] (1985) explained about the advantages of Dual flex wires which are given as Dual Flex-l, Dual Flex-2, and Dual Flex-3. Dual Flex-1 consists of a front section made of 0.016-inch round Titanal (Lancer Orthodontics) and a posterior section made of 0.016-inch round steel. The flexible front part easily aligns the anterior teeth and the rigid posterior part maintains the anchorage and molar control by means of the "V" bend, mesial to the molars. It is used at the beginning of treatment. The Dual Flex-2 consists of a flexible front segment composed of an 0.016 × 0.022-inch rectangular Titanal and a rigid posterior segment of round 0.018-inch steel. The Dual Flex-3, however, consists of a flexible front part of an 0.017 × 0.025-inch Titanal rectangular wire and a posterior part of 0.018 square steel wire. The Dual Flex-2 and 3 wires establish anterior anchorage and control molar rotation during the closure of posterior spaces. They also initiate the anterior torque.

José L. Zuriarrain[45](1996) experimented many bidimensional systems including The Spectrum bracket, combination bracket, based on a Siamese-type bracket design, Dual flex wires, Tandem archwires consisting of two arch wires that are used simultaneously on the same dental arc. They are formed by a flexible nickel-titanium tandem arch wire located in the horizontal slot and a vertical stabilizing arch wire inserted in the gingival wing slot. The flexible Titanal tandem wire can be made of round 0.016, square 0.018 × 0.018, or rectangular 0.016 × 0.022-inch. The second arch wire is a round 0.018-inch Australian steel arch wire, with intrusive bends at the molar and distal to the canine. These multiple arch wires are used to progressively align and torque the crowns and roots (achieved with the flexible Titanal arch wire in the straight wire slots), while, simultaneously, the arch form and vertical position of the molars and incisors are maintained by a rigid steel arch wire in the gingival slots, He concludes that. Combining treatment mechanics has proven very useful in the treatment of all types of malocclusions. Its versatility allows the use of either technique (edgewise or light wire) or both techniques; thereby, obtaining the advantage of being able to use the most effective attributes of either technique while eliminating disadvantages or the less effective mechanics of either technique.

Greco M[46], Giancotti A(2007). The Bidimensional technique is an edgewise technique in which 2 different sized vertically slotted brackets are used. On the central and lateral incisors, .018" x .022" brackets are placed on the central and lateral incisors and .022" x .028" brackets are placed on the canines, molars and premolars. The maxillary incisor brackets are programmed. All movements, including bodily retraction of the maxillary incisors are produced by sliding mechanincs. When retracting maxillary incisors, an .018" x. 022" wire which fills the vertical portion of the brackets, providing torque control, is inserted and 300 gm intra arch forces are placed for incisor retraction. In the buccal segments, the

.018" x .022" wire is undersized relative to the canine, premolar and molar brackets and can readily slide through the brackets and tubes.

Giancotti A[47], Greco M.(2010) They illustrated a modified archwire during space closure with anterior anchorage in Bidimensional Tecnique. The archwire used was a .018x.025 SS on the anterior teeth and .018 SS on the lateral and posterior teeth in order to maintain anterior anchorage using torque and uprighting springs as showed in Bidmensional Technique but exerting lighter forces (150 g). The double section archwire resulted to be an effective alternative option to optimize the lateral and posterior sliding mechanics with controlled tipping and by the application of lighter forces.

Tomio Ikegami[5,] describes the Hybrid Orthodontic Treatment System (HOTS), an innovative method used in first premolar extraction cases.It comprises the following three components: (1) a miniscrew, (2)dual-dimension wires, and (3) multiloop edgewise archwires consists of four clearly defined treatment steps: (1) setup, (2) leveling,(3) separate but simultaneous anterior and canine teeth retraction, and (4) final adjustment. HOTS achieves a predictable treatment outcome with a shorter treatment time.

Daniele Cantarella[48], Luca Lombardo, and Giuseppe Siciliani (2013) This article presented a clinical methodology aimed at minimizing binding in fixed orthodontic appliances. The dynforce archwire has a full size anterior segment (e.g. .021×.025) and undersized posterior segments with rectangular cross-section (e.g. .018×.025 or .018×.022), and is used in the orthodontic phase of space closure with or without TAD miniscrews.

MATERIALS AND METHODS

Among the patients reported to the Department of Orthodontics and Dentofacial Orthopaedics, Tamilnadu Government Dental College and Hospital, Chennai, for orthodontic treatment ,sixteen patients who fulfilled the inclusion and exclusion criteria were chosen as subjects in this study.Ethical clearance for conducting the study was obtained from the Institutional ethical committee of Tamilnadu Government Dental College and Hospital, Chennai .The study subjects were randomly selected for experimental group and control group.

Inclusion criteria:

- Age group - 18-25
- Patients undergoing orthodontic treatment with all the four 1st premolars extracted, and planned for enmasse retraction with Pre-adjusted Edgewise technique (MBT prescription).
- Patients whose treatment plan includes skeletal anchorage with miniscrews after completion of leveling and alignment

Exclusion criteria

- Patients with Skeletal malocclusion
- Medically compromised patients
- Patients under prolonged medication.
- history of trauma
- Past or present signs and symptoms of periodontal disease

All the patients (16) were randomly allocated into group A and Group B, with 8 patients in each group.No gender bias was made.

- Group A: 8 patients undergoing orthodontic treatment, to continue with Dual dimensional wires.
- Group B: 8 patients undergoing orthodontic treatment with conventional rectangular wire.

Armamentarium used for group A:

- Dual dimensional wire- 021 x .021x.018 (Speed System)
- Microimplant-1.5x 8 mm titanium implants from (Dentos)
- Driver for microimplant (Dentos)
- NiTi closed coil spring-9 mm(ormco)
- Plier (weingart)
- S hook(ormco)
- Modules(ormco)
- Study models (orthokal/stone)
- Lateral cephalograms (Planmeca PM 202 CC Proline)
- Vernier calipers(Robust)
- Dontrix gauge (Robust)
- Mouth mirror and probe

Armamentarium used for group B:

- Rectangular stainless steel wires- 021 x .025(G &H)
- Microimplant-1.5x 8 mm titanium implants from (Dentos)

- Driver for microimplant (Dentos)
- NiTi closed coil spring-9 mm(ormco)
- Plier (weingart)
- S hook(ormco)
- Modules (ormco)
- Study models (orthokal/stone)
- Lateral cephalogram (Planmeca PM 202 CC Proline)
- Vernier calipers(Robust)
- Dontrix gauge(Robust)
- Mouth mirror and Probe

Clinical procedure

After the leveling and alignment stage,the patients were grouped into two,one group to be treated with dual dimensional wire and the other to be treated with conventional rectangular stainless steel(21x25) wire.Impressions were taken with alginate and models were poured with Orthokal. Measurements were made for the position of canine, premolars and molars. (To).Preoperative lateral cephalogram was taken with 'L' shaped wire placed in the molar buccal tube on both the sides for easy identification[52] using cephalometric and panaromic radiographic unit – PLANMECA PM 202 CC PROLINE), by a single technician with same magnification.

A 0.017x 0.025-inch stainless steel wire is shaped in the form of an "L" with 0.5 cm of vertical length and 1 cm of horizontal length. The horizontal portion is inserted from the mesial side of the buccal tube and cinched behind the tube (so that it would not slip out of the tube) on the right side. On the left side, the wire is inserted from the distal surface of the buccal tube and cinched mesially to differentiate the right and left molars on the lateral cephalogram.

The vertical segment of the L-shaped wires abut the buccal tubes to minimize errors during superimposition.After the x rays were taken,the L shaped wire was removed. Intraoral peri apical radiographs were taken to analyse the structures and position for the placement of the microimplant.After confirming with the x ray, the area of operation was sterilized with povidone – iodine solution.With a straight probe, the area for the microimplant placement was marked both horizontally and vertically in the buccal cortex of the molar – premolar region of the upper arch. The micro screws were placed with the help of driver. The Dual dimensional wire and the Conventional Rectangular stainless steel wires were engaged in the upper arch in the respective groups. After three weeks, the implants were loaded by placing NiTi coil spring between the canines and the implant heads on both the sides.Force (Approx.150 gm.) produced was measured by Dontrix gauge (Robust, Germany).Patients were reviewed every 3 weeks.

At the end of the study period, NiTi coil springs were removed .Impressions were taken and models poured. (T2).Lateral cephalogram was taken with the Lshaped wire for easy identification.Treatment continued as routine, for all the patients after the study period.

Data Collection:

On Models T0-T1(Measurements)	On Cephalogram T0-T1 (Measurements)
1.Amount of space closure	1.Amount of space closure
2. Molar control	2.Molar control

Armamentarium for Cephalometric analysis: - (Fig 4)

1. Thin acetate tracing sheet of 0.003 inch thick and 8 x 12 inch size.
2. 0.5 mm lead pencil.
3. Eraser.
4. Ruler.
5. Set of protractors
6. X-ray viewer
7. Pre-Treatment lateral cephalogram (T0)
8. Post-Treatment lateral cephalogram (T1).

Armamentarium for Model analysis (Fig 5, 6)

1. Pre - Treatment study model (T0)
2. Post- Treatment study model (T1)
3. Transparent grid
4. Digital caliper (Robust)

The anteroposterior and transverse changes were measured in millimeters.The rotational changes were measured in degrees.

Calculation of amount of space closure

On cephalogram:

The anteroposterior distance between the Perpendicular drawn from the palatal plane to the distal surface of canine and mesial surface of 2nd premolar was measured at **T0 and T1**. In addition to the above, horizontal distance between the long axes of canine and 2nd premolar with reference to the occlusal plane was measured and the difference was calculated as the amount of space closure.

On Models*:*

Vernier calipers was used to measure the distance between the most prominent portion of distal surface of canine and the mesial surface of 2nd premolar bilaterally, in the upper arch at To and T1 in the study models.

Calculation of Molar control (To and T1)

For the maxillary measurements, the lateral cephalometric tracings taken at T0 and T1 were superimposed along the palatal plane registered at anterior nasal spine.In addition to the superimposition, the horizontal distance from pterygoid vertical to the distal surface of the first molar on both sides were calculated to measure anchorage loss[53]

Linear parameters

1. Ptv to right metallic marker (D1) - horizontal distance between pterygoid vertical line and metallic marker of right molar.
2. Ptv to left metallic marker (D2) - horizontal distance between pterygoid vertical line and metallic marker of left molar.

Angular parameters:

Ba-N plane and S-N planes were taken as reference planes.The angle formed between Ba-N plane and a line drawn through mesiabuccal cusp and distobuccal root was taken at T0 and T1.The difference in the values was taken as the change in the rotation of molars.Similiar measurements were taken with reference to S-N plane and the 1^{st} molar.The results were tabulated and analysed.The positions of premolar and canine were also measured as the angle formed between Ba-N and S-N planes and long axis of each tooth.The results were tabulated and analysed statistically.

On Models

The following reference points and reference planes were marked over the preoperative and postoperative study models and used for comparison.

- I.P (Incisive papilla perpendicular)- A perpendicular line drawn anteroposteriorly from the incisive papilla (Ip) on the mid palatine raphe.(midline-MID)
- MID M RT and MID M LT- A perpendicular drawn from the mesial pit of the maxillary permanent first molar to the incisive papilla perpendicular. (R-right and L-left side) and
- MID PM RT and MID PM LT- A perpendicular drawn from the central pit of the maxillary permanent second premolar to the incisive papilla perpendicular. (R-right and L-left side).
- MID C RT and MID C LT- A perpendicular drawn from the canine cusp to the incisive papilla perpendicular. (R-right and L-left side).

- M ANG RT and M ANG LT **(**MES)-Tangent projected from incisive papilla perpendicular to the mesial surface of the maxillary first molar (R-right and L-left side)
- M ANG RT and M ANG LT (DIS) – Tangent projected from incisive papilla perpendicular to the distal surface of the maxillary first molar. (R-right and L-left side)

Anteroposterior measurements:

The distance from the incisive papilla to the reference points marked from the canine, 2nd premolar and 1st molar,on the incisive papilla perpendicular, was measured at T0 and T1 .The changes were calculated to measure the amount of anteroposterior movements of these teeth.

Transverse changes in molar, premolar and canine position:-

The horizontal distance from the canine cusp, central pit of premolar and molar to the incisive papilla perpendicular was measured on both right and left sides (MID M, MID PM, MID C) on the pre and post-operative study models.The results were analysed and used for the determination of any expansion or contraction of molars and premolars.

Rotational changes of first molar:-

Tangents from the distal surface of the permanent first molars (MID ANG M-DIS) were projected to the I.P line of the grid and the angles formed were measured. The difference in the pre- and post-treatment angles was used to determine the rotation of first molar. The increase in the value denotes distolingual rotation. The decrease in the value denotes distobuccal rotation.

Same procedure followed for the mesial tangent projected to the I.P line of the grid and the angles formed were measured.

RESULTS

Results of this study were taken at two intervals (T0 and T1).T0 at the beginning of the study ,after alignment and leveling of all selected cases, with miniscrews implanted.T0 included cephalometric measurements and model analysis measurements .The study was conducted for a period of four months .T1 measurements were taken at the end of the study period, which included both cephalometric and model analysis measurements.

The results were tabulated and analyzed with SPSS (statistic package for social sciences) software version 16. The data obtained were parametric in nature as per the Shapiro Wilk’s test for normality.Paired sample test was done to compare the results obtained before and after the study period.Independent sample test was done to analyze and compare the individual parameters of the same group. $p<0.05$ was considered as statistically significant.

<u>Cephalometric measurements</u>

The cephalometric mean amount of space present at T0,when measured mesiodistally between 2^{nd} premolar and the canine of the upper arch, in the group A was 5.65 mm and group B was 5.96 mm.At T1 ,the measurement was 2.42 mm and1.97 respectively. The difference in the total amount of change in the space closure was 3.23 mm and 3.99 mm respectively, showing 0.76 mm more change in the group B,at the end of four months. The results were statistically significant(0.001).

The amount of space closure, when measured horizontally between the long axis of canine and 2^{nd} premolar in group A and group B was 3.48 and 3.9 mm respectively, with 0.42 mm more in group B

When molar control was measured by the perpendicular distance from ptV-6, the change found in group A was 0.125 whereas in group B was 0.22 mm but it was statistically insignificant. Angular measurements were made by taking two horizontal reference planes ,SN plane and Ba-N plane.The mean change in group A with reference to S-N plane,was 0.5° and 0°in group B and with refernce to Ba-N plane, the mean change was 1° and 0.25° respectively in group A and group B.

The change in premolar angulation was measured with reference to Ba-N plane.The mean change was 0° and -0.06° respectively between group A and group B.Change in Canine angulation was -6.75° and -8.5° respectively for group A and group B with reference to Ba-N plane and long axis of canines.

Model Analysis

Linear measurements:

The mean amount of space closure in group A was 3.31 mm and 4.01 in group B, when measured between canine and 2^{nd} premolar on the right side and 3.37 mm and 4.07 mm on the left side in group A and group B respectively.

The change in the mean distance between the midline and canine cusp measured to analyse canine control was 0 .12mm and 0mm in group A and group B respectively,on the right side and 0 and 0.25 mm respectively on the left side.

The change in the mean distance between the midline and central pit of premolar measured to analyse premolar control was -0.37 mm and -0.25mm between the groups A and B on the right side and 0.12mm and 0 mm on the left side respectively.The change in the mean distance between the midline and central groove of 1st molar measured to analyse molar control was -0.125mm and -0.125mm between the groups A and B on the right side whereas it was -0.25mm and -0.125 mm on the left side respectively.

Angular measurements

Molar control was analysed using grid .The angles made by the tangents made on the distal and mesial surfaces of 1st molar were measured.The mean change was -0.625° and -0.12 in groups A and B respectively on the distal tangent of the right molar and -0.625° and -0.125° on the mesial tangent respectively for group A and group B.

The mean change measured with the tangent on the distal side of the left side molar was 0.625° and 0°and on the mesial side was 0.625° and 0° respectively in group A and Group B.

Statistically significant Data

When comparing intragroup values in group A ,the change in the mesiodistal distance between canine and 2nd premolar was significant(p-0.001) indicating significant amount of space closure.The change in the canine angulation was significant (p-0.001).Model analysis shows that amount of space closure was significant on both the sides (p-0.001).Change in Molar angulation measurement on the mesial tangent showed borderline significance (p-0.005).

When comparing intragroup values in group B, the change in the mesiodistal distance between canine and 2nd premolar was significant(p-0.001),indicating significant amount of space closure.The change in the canine angulation was also significant,(p-0.001). Model analysis also showed that the amount of space closure was significant on both the sides (p-0.001).

Intergroup comparison

The amount of space closure was clinically and statistically significant when the distance between the canine and 2nd premolar was measured,with more value in group B.

The results concluded that 0.7 mm more amount of space closure occurred in group B than in group A.Though the changes in canine control and molar control showed significance when intragroup analyzing of both the groups were done,but when comparision were made between the groups ,the changes in the molar and canine angulations were statistically insignificant.

TABLES

GROUP A-Control Group Including Patients Undergoing Orthodontic Treatment with Rectangular Wire, During the Study Period. GROUP B-Experimental Group Including Patients Undergoing Orthodontic Treatment with Dual Dimensionalwire, During the Study Period

N=8 FOR ALL THE DESCRIPTIVE TABLES

TABLE-1= DESCRIPTIVE STUDY -GROUP A PRE TREATMENT CEPHALOMETRIC MEASUREMENTS

PARAMETER	MEAN	STANDARD DEVIATION
MES-DIS	5.6500	0.82115
L AXIS	10.7625	0.84505
PTV-6	23.8750	0.99103
ANG-SN-6	77.2500	1.75255
BAN-6	101.75	2.60494
BAN-PM	114.50	8.29802
BAN-C	108.12	5.46253

TABLE -1A DESCRIPTIVE STUDY -GROUP A POSTTREATMENT CEPHALOMETRIC ANALYSIS

PARAMETER	MEAN	STANDARD DEVIATION
MES-DIS	2.4250	0.70255
L AXIS	7.2750	0.81372
PTV-6	23.7500	1.75255
ANG-SN-6	76.7500	2.12132
BAN-6	100.75	2.71241
BAN-PM	108.12	5.43632
BAN-C	105.25	3.49489

TABLE-2 DESCRIPTIVE STUDY -GROUP B PRETREATMENT MODEL ANALYSIS

PARAMETER	MEAN	STANDARD DEVIATION
	N=8	
SPACE13TO14	5.4000	0.70912
SPACE23TO24	5.3500	0.69076
MIDCRT	18.3750	0.51755
MIDCLT	18.3750	0.51755
MIDPMRT	20.5000	0.75593
MIDPMLT	21.0000	0.75593
MIDMRT	22.6250	0.74402
MIDMLT	22.7500	0.46291
MID M ANG RT	22.1250	2.47487
MID M ANG LT	42.5000	2.67261
MANGRT	22.3750	2.32609
MANGLT	42.7500	2.49285

TABLE-2A DESCRIPTIVE STUDY GROUP B POSTTREATMENT MODEL ANALYSIS

PARAMETER	MEAN	STANDARD DEVIATION
	N=8	
SPACE 13-15	2.0875	0.55662
SPACE 23-25	1.9750	0.54968
MIDCRT	18.2500	0.46291
MIDCLT	18.3750	0.51755
MID PM RT	20.8750	0.64087
MIDPMLT	20.8750	0.83452
MIDMRT	22.7500	0.70711
MIDMLT	23.0000	0.53452
M ANG DIS RT	22.7500	2.37547
M ANG MES RT	43.1250	2.35660
M ANG DIS LT	21.7500	3.19598
M ANG MES LT	42.1250	3.48210

TABLE-3 = DESCRIPTIVE STUDY -GROUP B PRE TREATMENT CEPHALOMETRIC MEASUREMENTS

PARAMETER	MEAN	STANDARD DEVIATION
	N=8	
MESDIS	5.9625	0.63005
LONGAXIS	12.0875	0.82883
PTV6	24.0000	1.92725
ANGSN6	75.2500	4.65219
BAN6	94.7500	5.17549
BANPM	1.1275E2	4.52769
BANC	1.0225E2	6.06512

TABLE-3A- DESCRIPTIVE STUDY -GROUP B POST TREATMENT CEPHALOMETRIC MEASUREMENTS

PARAMETER	MEAN	STANDARD DEVIATION
	N=8	
MESDIS	1.9750	0.69024
LONGAXIS	8.1875	1.72580
PTV6	23.7750	1.92854
ANGSN6	75.2500	4.46414
BAN6	94.7500	5.31171
BANPM	1.1281E2	4.20830
BANC	1.1075E2	6.75595

TABLE -4 DESCRIPTIVE STUDY -GROUP B PRETREATMENT MODEL ANALYSIS MEASUREMENTS

PARAMETER	MEAN	STANDARD DEVIATION
	N=8	
SPACE 13-15	5.8500	0.62335
SPACE 23-25	5.9000	0.52915
MIDCRT	18.2500	0.46291
MIDCLT	18.5000	0.53452
MID PM RT	20.5000	0.75593
MIDPMLT	20.7500	0.70711
MIDMRT	22.5000	0.53452
MIDMLT	22.7500	0.46291
M ANG DIS RT	22.7500	2.49285
M ANG MES RT	42.5000	2.67261
M ANG DIS LT	23.6250	1.99553
M ANG MES LT	43.3750	2.32609

TABLE -4A DESCRIPTIVE STUDY -GROUP B POSTTREATMENT MODELANALYSIS

PARAMETER	MEAN	STANDARD DEVIATION
SPACE13-15	1.8375	0.61630
SPACE23-25	1.8250	0.43997
MIDCRT	18.2500	0.46291
MIDCLT	18.2500	0.46291
MIDPMRT	20.7500	0.70711
MIDPMLT	20.7500	0.88641
MIDMRT	22.6250	0.74402
MIDMLT	22.8750	0.35355
M ANG DIS RT	22.8750	2.64237
M ANG MES RT	42.6250	2.82527
MANG DIS LT	23.6250	1.99553
MANG MESLT	43.3750	2.32609

TABLE -5 INTRA GROUP COMPARISION OF PRE-POST TREATMENT VALUES- GROUPA -CEPHALOMETRIC MEASUREMENTS –Space Closure and Molar Position

PARAMETER	MEAN	STANDARD DEVIATION	SIG (2 TAILED)
MES-DIS PRE	5.6500	0.82115	0.0001
MES-DIS POST	2.4250	0.70255	
LONGAXIS PRE	10.7625	0.84505	0.0001
LONGAXIS POST	7.275	0.81372	
PTV-6 PRE	23.8750	0.99103	0.850
PTV-6 POST	23.7500	1.75255	

TABLE -6 INTRA GROUP COMPARISION OFPRE-POST TREATMENT VALUES- GROUPA -CEPHALOMETRIC MEASUREMENTS – MOLAR POSITION (angle)

PARAMETER	MEAN	STANDARD DEVIATION	SIG (2 TAILED)
ANG SN-6 PRE	77.2500	1.75255	0.170
ANG SN-6 POST	76.7500	2.12132	
BA-N-6 PRE	101.75	2.60494	0.121
BA-N-POST	100.75	2.71241	
BA-PM PRE	112.75	4.52769	0.844
BA-PM POST	112.81	4.20830	
BA-C PRE	98.500	1.9275	0.001
BA-C POST	105.25	3.4948	

The mean molar angular changes with respect to SN plane was 0.5° and with respect to Ba-N Plane was 1°, no change in the PM position was found while.-6.75° was found in canine angulation, but the results were insignificant statistically

TABLE -7 INTRA GROUP COMPARISION OF GROUPA (MODEL ANALYSIS –FOR SPACE CLOSURE

PARAMETER	MEAN	STANDARD DEVIATION	SIG (2 TAILED)
SPACE 13-15PRE	5.4000	0.70912	0.001
SPACE 13-15 POST	2.0875	0.55662	
SPACE 23-25 PRE	5.3500	0.69076	0.001
SPACE 23-25 POST	1.9750	0.54968	

The total amount of space closure observed on the right side was 3.31mm and on the left side was3.37mm.The change was observed slightly more (0.06mm) on the left side and the changes were statistically significant.

TABLE -8 COMPARISION OF GROUPA WITHIN THE GROUP (INTRA GROUP) TRANVERSE CONTROL MODEL ANALYSIS –LINEAR MEASUREMENT BETWEEN MIDLINE TO CANINE, 2ND PREMOLAR AND 1ST MOLAR

PARAMETER		MEAN	STANDARD DEVIATION	SIG (2 TAILED)
MID-C –RT	T0	18.375	0.51755	0.351
	T1	18.25	0.46291	
MID C –LT	T0	18.3750	0.51755	1.000
	T1	18.375	0.51755	
MID PM RT	T0	20.50	0.75593	0.080
	T1	20.875	0.64087	
MID PM LT	T0	21.00	0.75593	0.598
	T1	20.875	0.83452	
MID M RT	T0	22.625	0.74402	0.351
	T1	22.750	0.70711	
MID M LT	T0	22.750	0.46291	0.170
	T1	23.000	0.53452	

The transverse change observed with the canines were,0.125mm on the right side and 0 mm on the left side,showing minimal change on the right side canine.The change observed in the premolars were -.37mm and -.12mm on the right and left side respectively.Observations made on the right and left molars were -.125mm and -.25mm respectively. These results were statistically insignificant

TABLE -9 INTRA GROUP COMPARISION OF GROUPA -MODEL ANALYSIS –ANGULAR MEASUREMENT OF 1ST MOLAR WITH RESPECT TO MIDLINE-ROTATIONAL CONTROL

PARAMETER			MEAN	STANDARD DEVIATION	SIG (2 TAILED)
M ANG RT	DIS	T0	22.3750	2.3260	0.217
		T1	21.7500	3.1959	
	MES	T0	42.500	2.672	0.049
		T1	43.125	2.3566	
M ANG LT	DIS	T0	22.125	2.4748	0.049
		T1	22.75	2.3754	
	MES	T0	42.750	2.4928	0.217
		T1	42.125	3.4821	

The mean change in the molar rotation was -.625° both on the mesial tangent of right molar distal tangent of left side molar.The result was borderline statistically significant. (p-0.49)

TABLE -10 INTRA GROUP COMPARISION OF GROUP B CEPHALOMETRIC MEASUREMENTS

PARAMETER		MEAN	STANDARD DEVIATION	SIG (2 TAILED)
MES-DIS	PRE	5.9625	0.63005	0.001
	POST	1.9750	0.69024	
LONGAXIS	PRE	12.0875	0.82883	0.001
	POST	8.1875	1.72580	
PTV-6	PRE	24.0000	1.92725	0.229
	POST	23.7750	1.92854	

The mean distance mesiodistally measured across the extraction space was 5.96 mm and 1.97mm at T0 AND T1 respectively.The mean Long axis difference was 3.9 mm and was statistically significant.p=0.001.The changes seen in molar position was 0.22 mm and was not statistically significant

TABLE -11 INTRA GROUP COMPARISION OF GROUP B CEPHALOMETRIC MEASUREMENTS- ROTATIONAL CONTROL

PARAMETER	MEAN	STANDARD DEVIATION	SIG (2 TAILED)
ANG SN-6 PRE	75.2500	4.65219	1.000
ANG SN-6 POST	75.2500	4.46414	
BA-N-6 PRE	94.7500	5.17549	1.000
BA-N-POST	94.7500	5.31171	
BA-PM PRE	112.75	4.52769	0.844
BA-PM POST	112.81	4.20830	
BA-C PRE	102.25	6.06512	0.001

The mean molar angular changes with respect to SN plane was 0° and with respect to Ba-N Plane was .25°, change in the PM position was found to be -.06°, while.-8.5° was found in canine angulation. The change in the canine angulation was found to be statistically significant.p=0.001

TABLE-12 INTRA GROUP COMPARISION OF GROUPB -MODEL ANALYSIS –FOR SPACE CLOSURE

PARAMETER		MEAN	STANDARD DEVIATION	SIG (2 TAILED)
SPACE 13-15	PRE	5.8500	0.62335	0.001
	POST	1.8375	0.61630	
SPACE 23-25	PRE	5.9000	0.52915	0.001
	POST	1.8250	0.43997	

The total amount of space closure observed on the right side was 4.01mm and on the left side was4.07mm.The change was observed slightlymore(0.06mm) on the left side and the changes were statistically significant.p=0.001

TABLE-13 INTRA GROUP COMPARISION OF GROUP B-MODEL ANALYSIS –LINEAR MEASUREMENT BETWEEN MIDLINE TO CANINE, 2ND PREMOLAR AND 1ST MOLAR TRANSVERSE CONTROL

PARAMETER		MEAN	STANDARD DEVIATION	SIG (2 TAILED)
MID-C –RT	T0	18.250	0.46291	-
	T1	18.250	0.46291	
MID C –LT	T0	18.5000	0.53452	0.170
	T1	18.2500	0.46291	
MID PM RT	T0	20.5000	0.75593	0.170
	T1	20.7500	0.70711	
MID PM LT	T0	20.7500	0.70711	1.000
	T1	20.7500	0.88641	
MID M RT	T0	22.5000	0.53452	0.351
	T1	22.6250	0.74402	
MID M LT	T0	22.7500	0.46291	0.351
	T1	22.8750	0.35355	

The transverse change observed with the canines were,0mm on the right side and o.25mm on the left side,showing minimal change on the left side canine.The change observed in the premolars were -..25mm and 0 mm on the right and left side respectively.Observations made on the right and left molars were -.125mm and -.125mm respectively. These results were statistically insignificant

TABLE-14 INTRA GROUP COMPARISION OF GROUPB MODEL ANALYSIS –ANGULAR MEASUREMENT OF 1ST MOLAR WITH RESPECT TO MIDLINE.ROTATIONAL CONTROL

PARAMETER			MEAN	STANDARD DEVIATION	SIG (2 TAILED)
M ANG RT	DIS	T0	22.7500	2.49285	0.351
		T1	22.8750	2.64237	
	MES	T0	42.5000	2.67261	0.351
		T1	42.6250	2.82527	
M ANG LT	DIS	T0	23.625	1.99553	-
		T1	23.625	1.99553	
	MES	T0	43.375	2.32609	-
		T1	43.375^{A}	2.32609	

The mean change in the molar rotation was -.125° both on the distal and mesial side of right side molar and 0° change on the left side molar. The result was statistically insignificant.

TABLE-15 DIFFERENCE CALCULATION -GROUP A VS GROUP B-CEPHALOMETRIC MEASUREMENTS

PARAMETER		MEAN	STANDARD DEVIATION	SIG (2 TAILED)
MES-DIS	GROUP A	3.2250	0.47734	0.015
	GROUP B	3.9875	0.61047	0.015
LONGAXIS	GROUP A	3.4875	0.73180	0.507
	GROUP B	3.9000	1.55012	0.512
PTV-6	GROUP A	.1250	1.80772	0.882
	GROUP B	.2250	0.48329	0.884

The difference in the total amount of change in the space closure was 3.23 mm and 3.98 mm respectively ,showing 0.76 mm more change in the group B,at the end of four months.The results were statistically significant.(p=0.015). The amount of space closure, when measured horizontally between the long axis of canine and 2nd premolar in group A and group B was 3.48 and 3.9 mm respectively, with 0.42 mm more in group B

When molar control was measured by ptV-6, the change found in group A was 0.125 whereas in group B was 0.22 mm but it was statistically insignificant

TABLE-16 DIFFERENCE CALCULATION -GROUP A VS GROUP B-CEPHALOMETRIC MEASUREMENTS –ROTATIONAL CONTROL

PARAMETER	MEAN	STANDARD DEVIATION	SIG (2 TAILED)
ANG SN-6 PRE	.5000	0.92582	0.207 0.212
ANG SN-6 POST	.0000	0.53452	
BA-N-6 PRE	1.0000	1.60357	0.266 0.272
BA-N-POST	.2500	0.88641	
BA-PM PRE	.0000	3.11677	0.957 0.958
BA-PM POST	-.0625	0.86344	
BA-C PRE	-6.7500	2.25198	0.128 0.128
BA-C POST	-8.5000	2.07020	

The mean change in group A with reference to S-N plane,was 0.5° and in group B it was 0.0°.with reference to Ba-N plane, the mean change was 1° and 0.25° respectively .The change in premolar angulation was measured with reference to Ba-N plane.The mean change was .0° and -.06° respectively between group A and group B.Change in Canine angulation was -6.75° and -8.5° respectively for group A and group B with reference to Ba-N plane and long axis of canines.The changes were statistically insignificant.

TABLE -17 DIFFERENCE CALCULATION -GROUP A VS GROUP B - MODEL ANALYSIS - SPACE CLOSURE

PARAMETER		MEAN	STANDARD DEVIATION	SIG (2 TAILED)
SPACE 13-15	GROUP A	3.3125	0.40861	0.001
	GROUP B	4.0125	0.27999	0.002
SPACE 23-25	GROUP A	3.3750	0.48329	0.005
	GROUP B	4.0750	0.36154	0.006

The mean amount of space closure in group A was 3.31 mm and 4.01 in group B, when measured between canine and 2nd premolar on the right side and 3.37 mm and 4.07 mm on the left side in group A and group B respectively. The changes are more in the group B –about 0.7mm

TABLE-18 DIFFERENCE CALCULATION -GROUP A VS GROUP B - MODEL ANALYSIS -LINEAR MEASUREMENT BETWEEN MIDLINE TO CANINE, 2ND PREMOLAR AND 1ST MOLAR-TRANSVERSE CONTROL

PARAMETER		MEAN	STANDARD DEVIATION	SIG (2 TAILED)
MID-C –RT	T0	0.1250	0.35355	0.334
	T1	0	0	0.351
MID C –LT	T0	0	0.53452	0.334
	T1	0.2500	0.46291	0.335
MID PM RT	T0	-0.3750	0.51755	0.619
	T1	-0.2500	0.46291	0.619
MID PM LT	T0	0.1250	0.64087	0.727
	T1	0	0.75593	0.727
MID M RT	T0	-0.1250	0.35355	1.000
	T1	-0.1250	0.35355	1.000
MID M LT	T0	-0.2500	0.46291	0.554
	T1	-0.1250	0.35355	0.554

The change in the mean distance between the midline and central pit of premolar measured to analyse premolar control was -.37 mm and -.25mm between the groups Aand B., on the right side and .12 and .00 on the left side respectively. The change in the mean distance between the midline and central groove of 1st molar measured to analyze molar control was -.125mm and -.125mm between the groups Aand B on the right side whereas it was -.25mm and -.125 mm on the left side respectively.

TABLE-19 MODEL ANALYSIS –ANGULAR MEASUREMENT OF 1ST MOLAR WITH RESPECT TO MIDLINE-BETWEEN THE GROUPS ROTATIONAL CONTROL

PARAMETER			MEAN	STANDARD DEVIATION	SIG (2 TAILED)
M ANG RT	DIS	GROUP A	-0.6250	0.74402	0.108
		GROUP B	-0.1250	0.35355	0.117
	MES	GROUP A	-0.6250	0.74402	0.108
		GROUP B	-0.1250	0.35355	0.117
M ANG LT	DIS	GROUP A	0.6250	1.30247	0.196
		GROUP B	0	0	0.217
	MES	GROUP A	0.6250	1.30247	0.196
		GROUP B	0	0	0.217

The mean change was -0.625° and -0.12 in groups A and B respectively on the distal tangent of the right molar and -0.625° and -0.125° on the mesial tangent respectively between group A and group B.

The mean change measured with the tangent on the distal side of the left side molar was 0.625° and 0°and on the mesial side was 0.625° and 0° respectively in group A and Group B. There was no change in the group B and minimal change in group A and both were statistically insignificant.

TABLE 20 GROUP A-PRE-POST TREATMENT INCISIVE PAPILLA -1ST MOLAR, 2NDPREMOLAR AND CANINE –MODEL ANALYSIS LEFT SIDE

PARAMETER	MEAN	STANDARD DEVIATION	SIG (2 TAILED)
I.P.-6 PRE	23.1250	0.69437	0.59
I.P.-6 POST	22.8375	0.54232	
I.P.-5 PRE	12.6	0.54248	-
I.P.-5 POST	12.6	0.54248	
I.P.-3 PRE	3.05	0.21381	0.56
I.P.-3 POST	3.3125	0.32705	

TABLE 21 GROUP A –PRE-POST TREATMENT MODEL ANALYSIS-INCISIVE PAPILLA -A.P.CONTROL RIGHT SIDE

PARAMETER	MEAN	STANDARD DEVIATION	SIG (2 TAILED)
I.P.-6 PRE	23.125	0.69437	0.62
I.P.-6 POST	23.8625	0.55432	
I.P.-5 PRE	12.5	0.53148	-
I.P.-5 POST	12.5	0.53148	
I.P.-3 PRE	3.025	0.21451	0.057
I.P.-3 POST	3.1875	0.31735	

TABLE 22- GROUP B –PRE-POST TREATMENT MODEL ANALYSIS-INCISIVE PAPILLA -A.P.CONTROL RIGHT SIDE

PARAMETER	MEAN	STANDARD DEVIATION	SIG (2 TAILED)
I.P.-6 PRE	22.8375	0.54232	.043
I.P.-6 POST	22.7875	0.57678	
I.P.-5 PRE	12.6	0.54248	0.222
I.P.-5 POST	12.38	0.49696	
I.P.-3 PRE	3.05	0.21381	0.620
I.P.-3 POST	3.378	0.42178	

TABLE 23 GROUP B-PRE-POST TREATMENT MODEL ANALYSIS-INCISIVE PAPILLA -A.P.CONTROL LEFT SIDE

PARAMETER	MEAN	STANDARD DEVIATION	SIG (2 TAILED)
I.P.-6 PRE	22.7	0.53232	0.652
I.P.-6 POST	22.6	0.55678	
I.P.-5 PRE	12.525	0.59248	0.224
I.P.-5 POST	12.575	0.59686	
I.P.-3 PRE	3.05	0.21381	0.045
I.P.-3 POST	3.21	0.34178	

CHARTS

CHART-1 GROUP A PRE-POST TREATMENT – CEPHALOMETRIC ANALYSIS

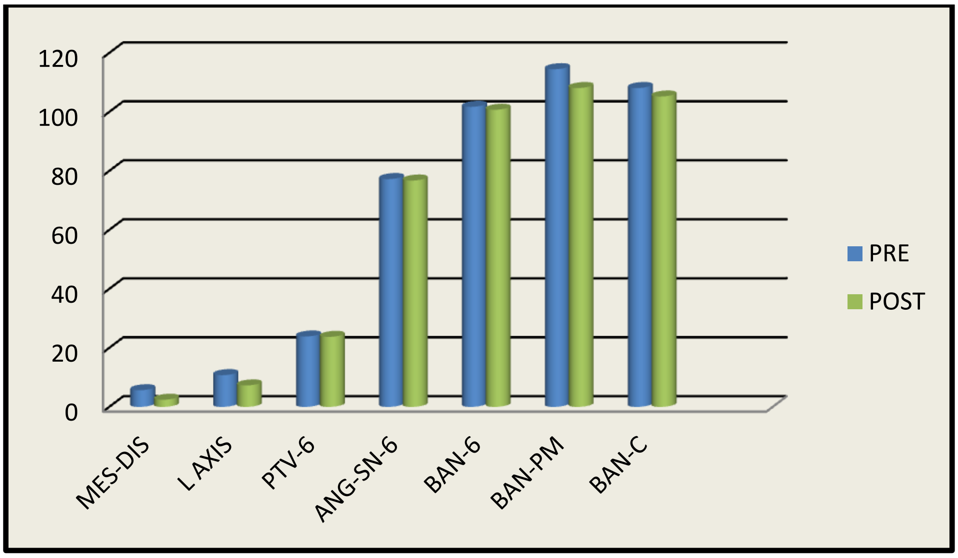


CHART-2 GROUP A PRE-POST TREATMENT – CEPHALOMETRIC ANALYSIS

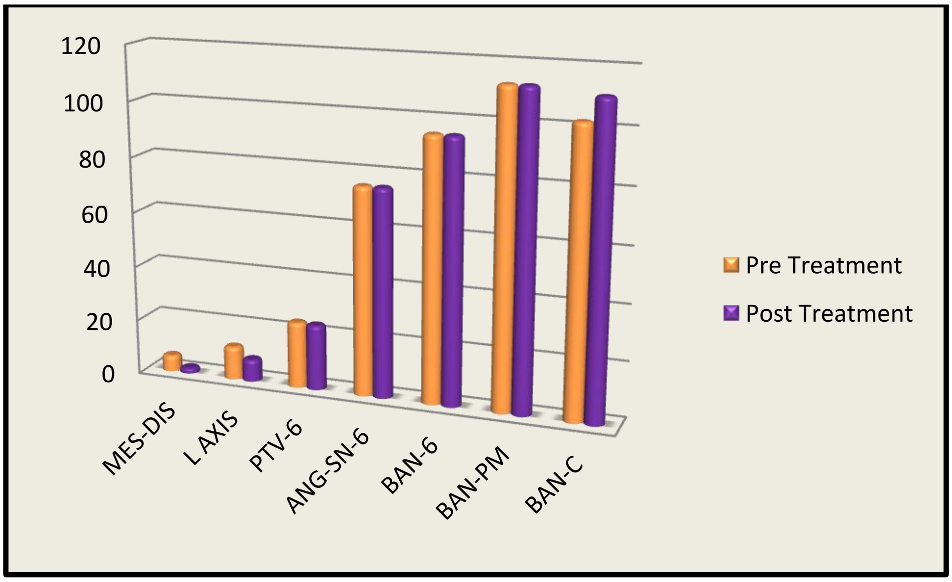


CHART -3 Intra Group Comparision Of Group A - Cephalometric Analysis

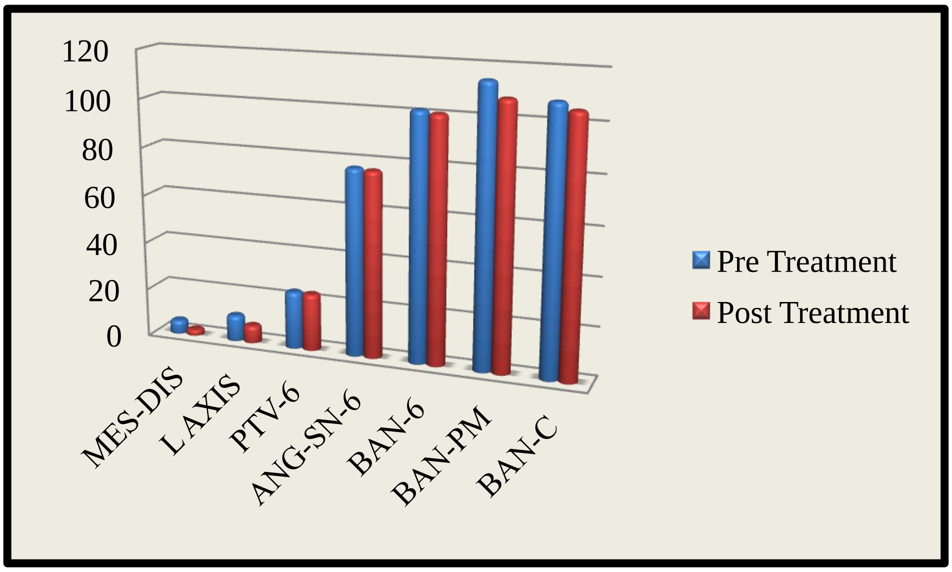


CHART-4 Intra Group comparison Of Group A -Model Analysis – Transverse(Linear Measurement Between Midline To Canine, 2nd Premolar And 1st Molar)

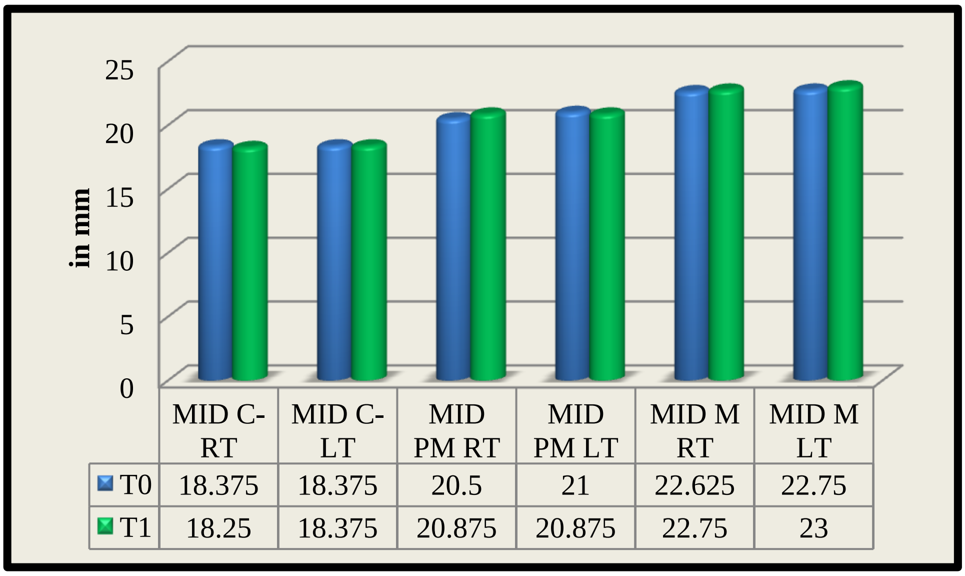


CHART 5-Intra Group Comparision Of GroupA -Model Analysis –Angular Measurement Of 1st Molar With Respect To Midline DISTAL

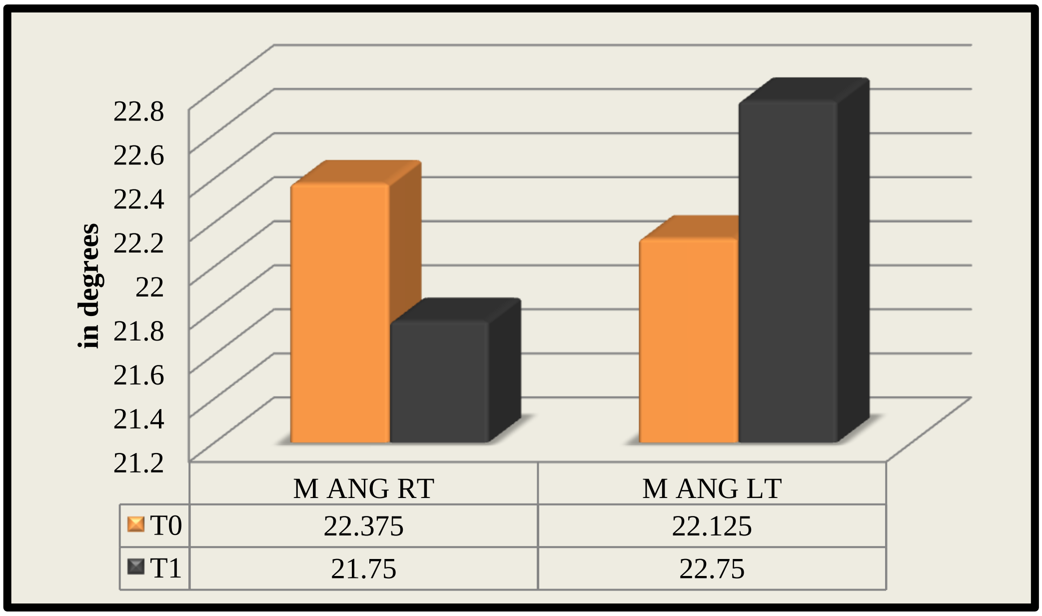


CHART 6-Intra Group Comparison Of GroupA -Model Analysis –Angular Measurement Of 1st Molar With Respect To Midline -MESIAL

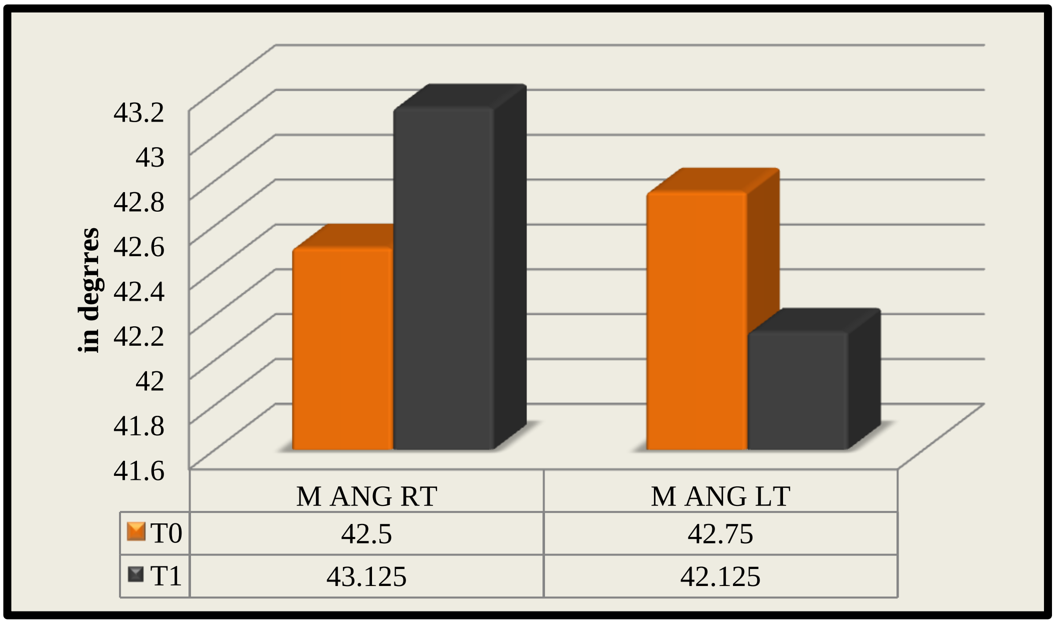


CHART 7-Intra Group Comparison Of GroupB -Model Analysis For Space Closure

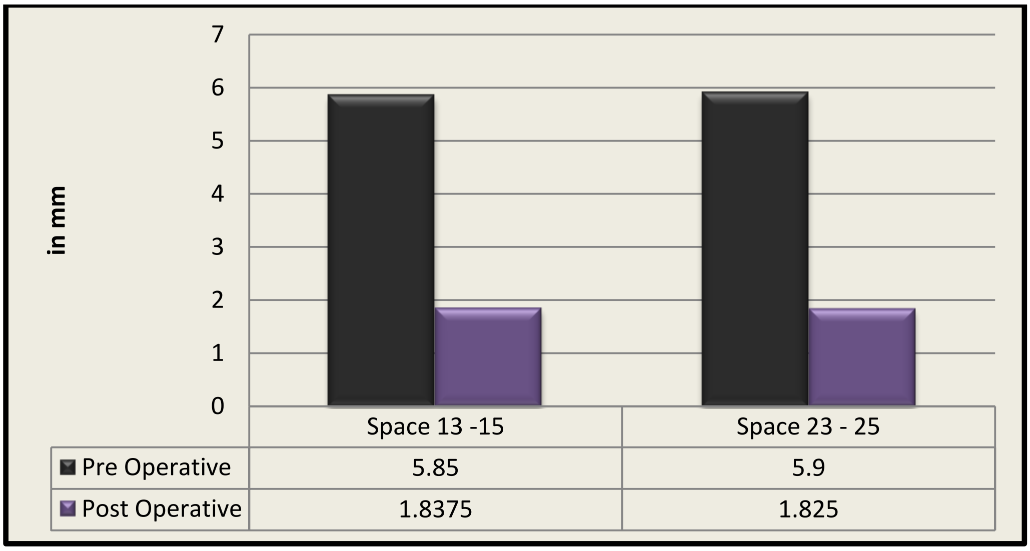


CHART 8-Comparison of GroupB within the group (intra group) Model analysis –Angular measurement of 1st molar with respect to midline.

DISTAL

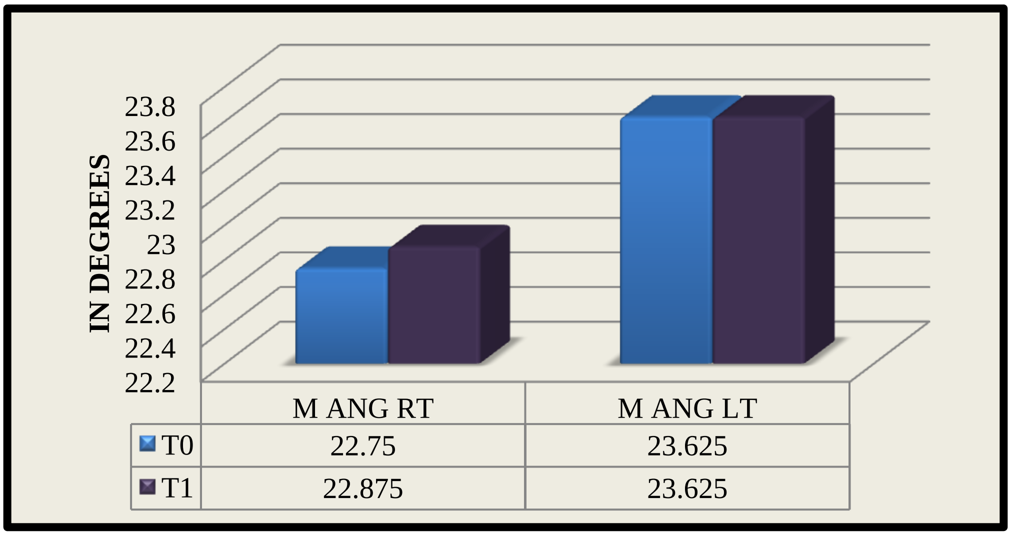


CHART 9-Comparison of GroupB within the group (intra group)Model analysis –Angular measurement of 1st molar with respect to midline.

MESIAL

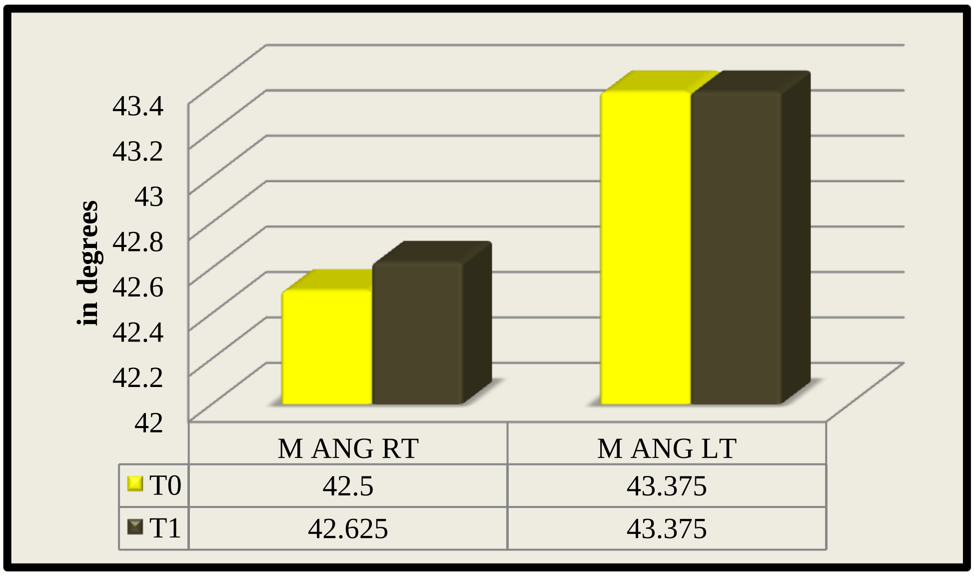


CHART 10-Difference Calculation -Group A Vs Group B-Cephalometric Measurements-Space Closure

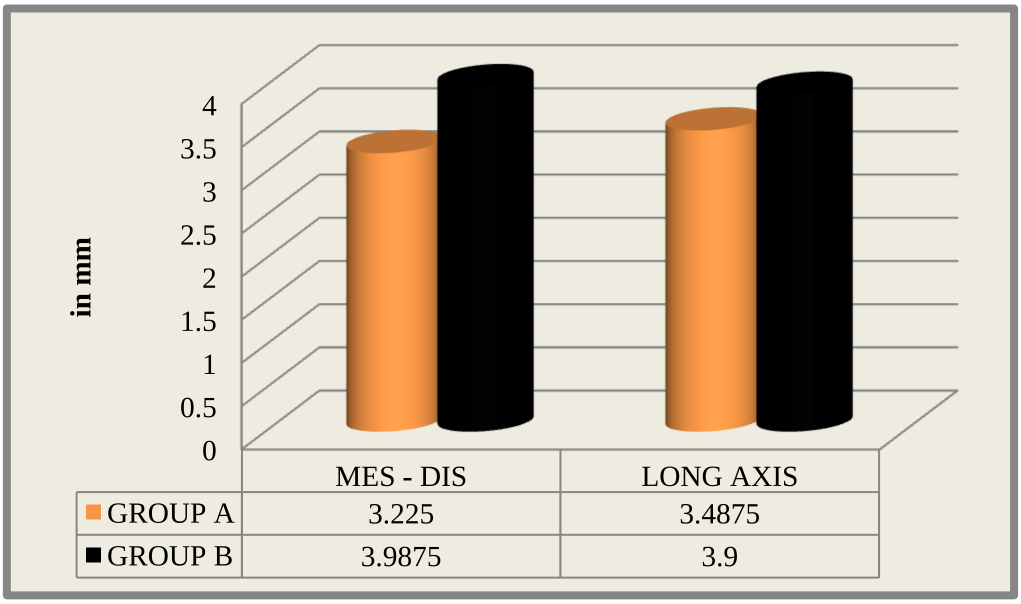
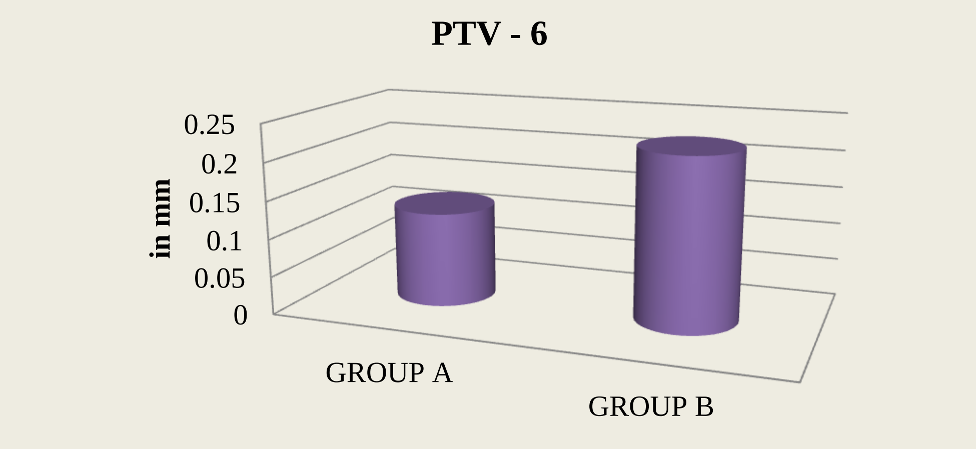
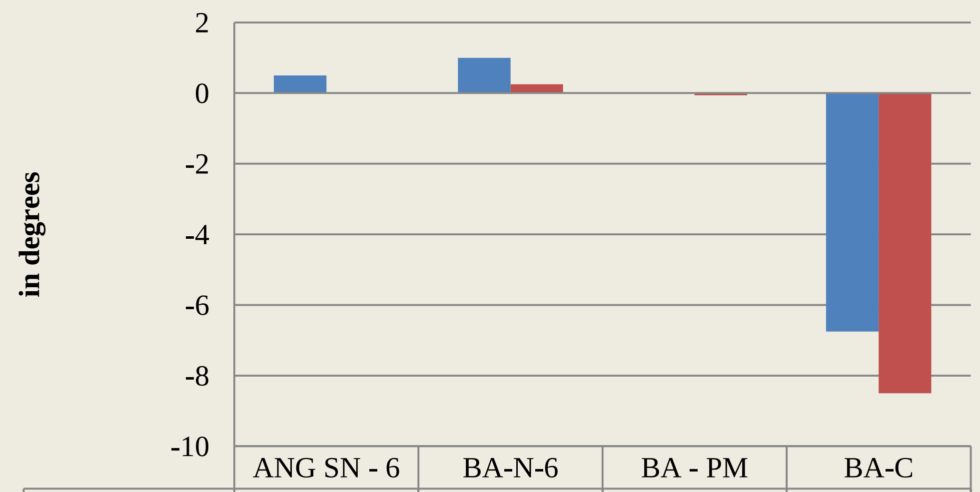


CHART-11 Difference Calculation -Group A Vs Group B-Cephalometric Measurement-Molar position



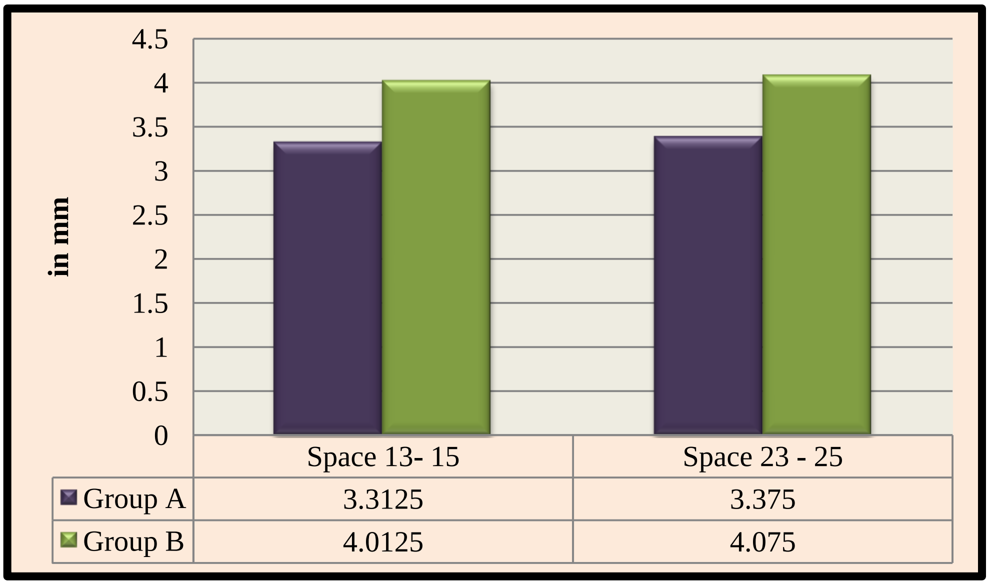
	GROUP A	GROUP B
PTV - 6	0.125	0.225

CHART-12 Difference Calculation -Group A Vs Group B-Angular Changes - Cephalometric Measurements –molar rotation



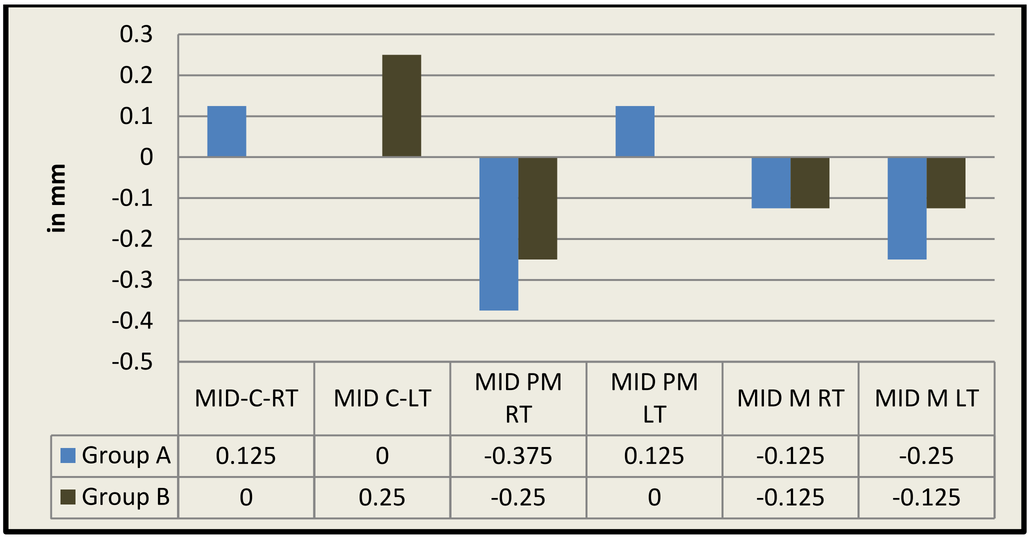
	ANG SN - 6	BA-N-6	BA - PM	BA-C
Pre Operative	0.5	1	0	-6.75
Post Operative	0	0.25	-0.0625	-8.5

CHART-13 Difference Calculation -Group A Vs Group B -Model Analysis -Horizontal Distance Between Canine And The 2nd Premolar - Space Closure



	Space 13- 15	Space 23 - 25
Group A	3.3125	3.375
Group B	4.0125	4.075

CHART-14-Difference Calculation -Group A Vs Group B -Model Analysis -Linear Measurement Between Midline To Canine,2nd Premolar And 1st Molar



	MID-C-RT	MID C-LT	MID PM RT	MID PM LT	MID M RT	MID M LT
Group A	0.125	0	-0.375	0.125	-0.125	-0.25
Group B	0	0.25	-0.25	0	-0.125	-0.125

CHART 15-Difference Calculation-Model Analysis –Angular Measurement Of 1st Molar With Respect To Midline-Between The Groups -Rotational Changes

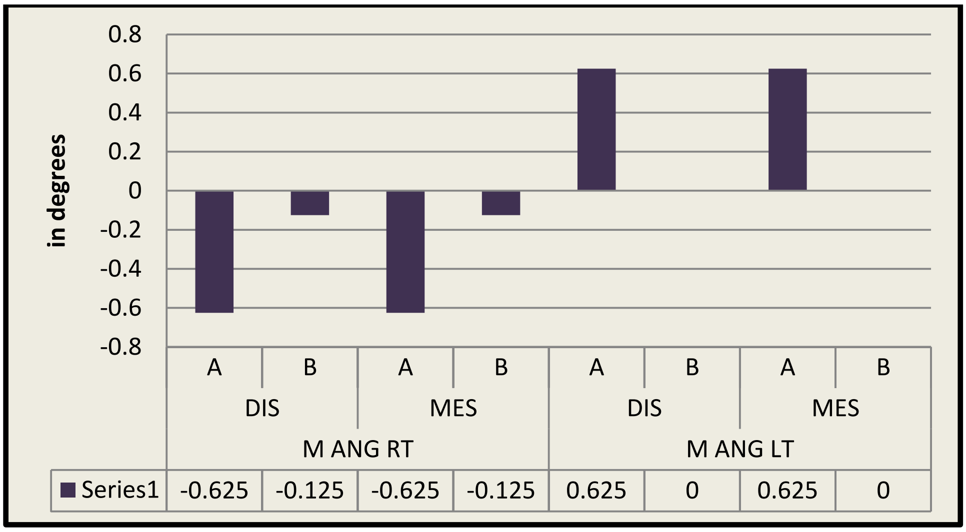
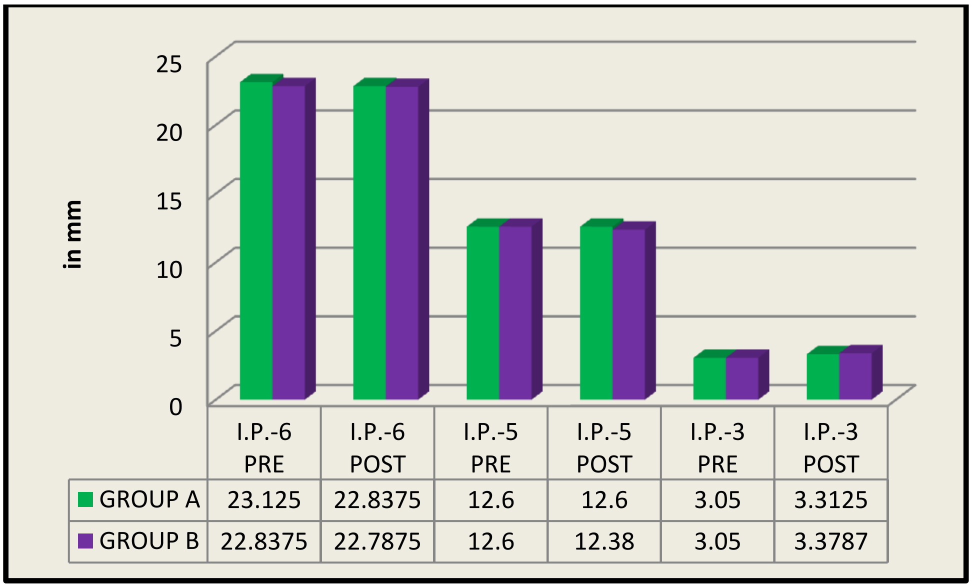


CHART 16 -Model Analysis –Anteroposterior Measurement Of 1st Molar ,2nd Premolar And Canine From The Incisive Papilla On The Midline-Between The Groups

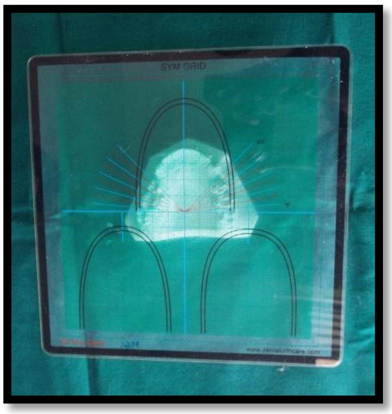


ARMAMENTARIUM

Fig.1- CEPHALOMETRIC RADIOGRAPHIC UNIT

Fig.2- IMPLANT KIT

Fig.3 –ARCHWIRE ,SPRINGS,HOOKS,DONTRIX GUAGE



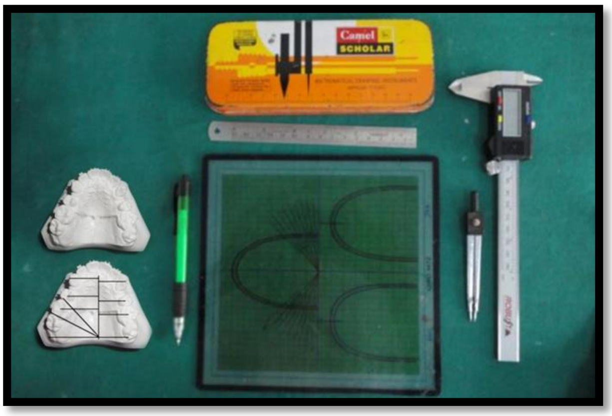


Fig .4-MODEL WITH GRID

Fig .5-MODEL ANALYSIS

Fig.6-X RAY VIEWER FOR CEPHALOMETRIC TRACING

INTRA ORAL PERI APICAL –XRAY

PRE-POST GROUP A PRE-POST GROUP B

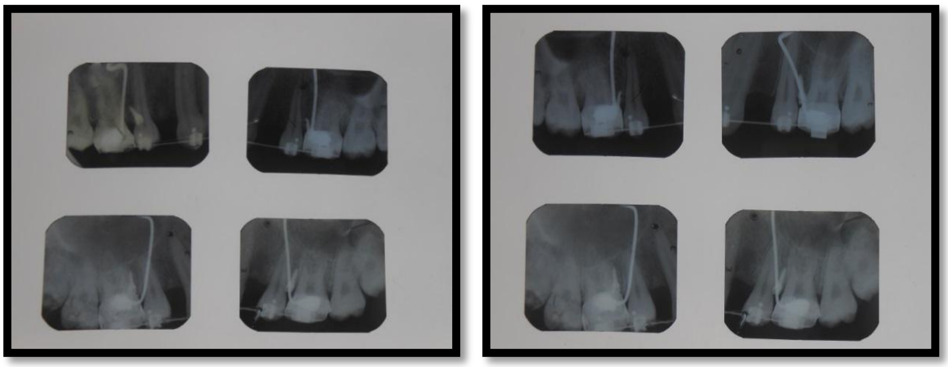


Fig.7-IOPA X Ray

MODELS- GROUP –A

Fig.8-PRE TREATMENT LATERAL VIEWS

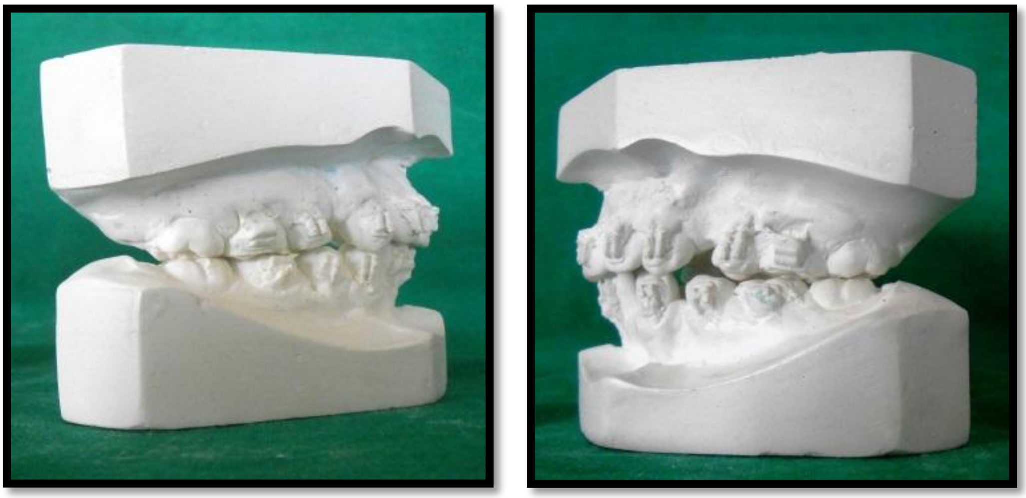


Fig.-9 POST TREATMENT LATERAL VIEWS

MODEL S- GROUP –B

Fig.10 PRE TREATMENT LATERAL VIEWS

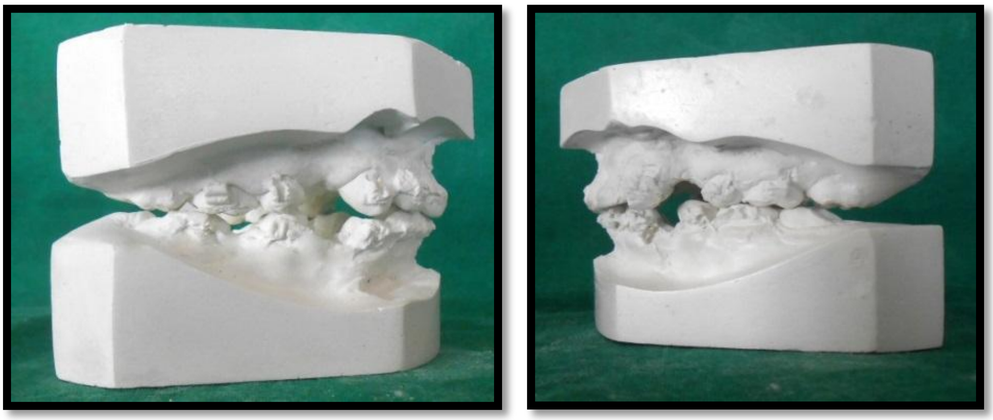


Fig. 11 POST TREATMENT LATERAL VIEWS

MODELS-GROUP A

OCCLUSAL VIEW

Fig.12 PRE TREATMENT

Fig. 13 POST TREATMENT

MODELS GROUP B

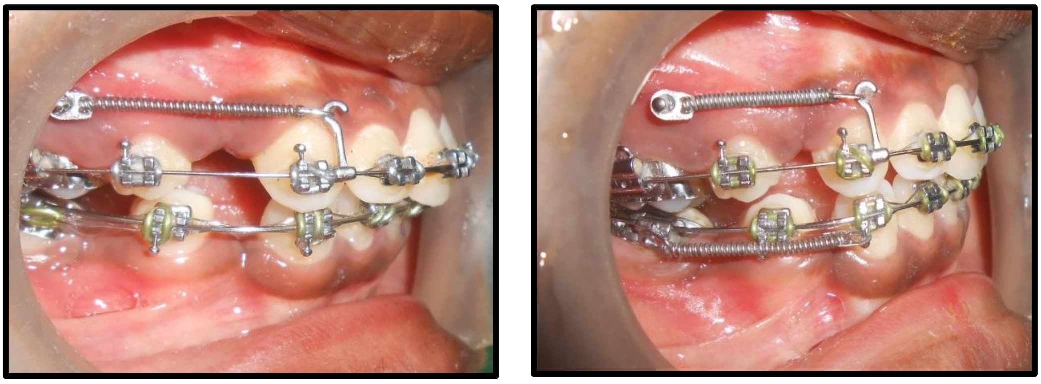
OCCLUSAL VIEW

Fig.14 PRE TREATMENT

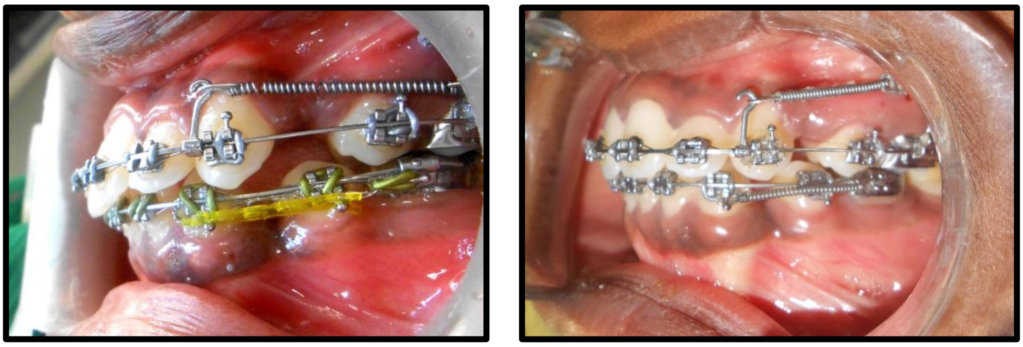
Fig.15 POST TREATMENT

Fig.17 GROUP B -CLINICAL PICTURES

PRE –TREATMENT POST –TREATMENT



Right Lateral View



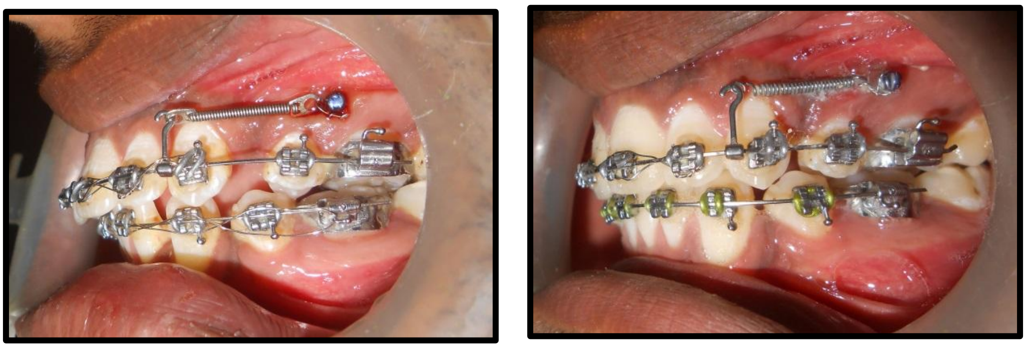
Left Lateral View

Occlusal View

Fig.16 GROUP A -CLINICAL PICTURES

PRE –TREATMENT **POST –TREATMENT**

Right Lateral View



Left Lateral View

Occlusal View

Fig.18 CEPHALOMETRIC ANALYSIS

GROUP A

Pre-Treatment -T0

Post-Treatment –T1

Fig.19 CEPHALOMETRIC ANALYSIS

GROUP B

Pre-Treatment -T0

Post-Treatment –T1

DISCUSSION

One of the major concerns of Orthodontics has been the development of techniques that could adequately control anchorage units in the selective movement of individual teeth or groups of teeth along with faster tooth movement.

Sliding mechanics for en-masse retraction of the anterior teeth have become more common with increased use of preadjusted appliances. The same has been followed in this study, as recommended by the authors of MBT bracket system. If there were acceptable anchorage devices, it would be more reasonable to retract the six anterior teeth simultaneously in one rather than two steps. Generally, Rectangular wires are used to retract the anterior teeth during space closure in sliding mechanics. Though torque expression is excellent with these wires, there are two constraints faced, commonly.

- Loss of posterior control-anchor loss.
- resistance to sliding

Clinicians throughout the years have made an effort to find biomechanical solutions to control anchorage.Tweed[51] (1941), Holdaway [52](1952) and Merrifield[53] (1985) developed different types of anchorage preparation to increase the efficacy of treatment. Tweed[54] emphasized anchorage preparation as the first step in orthodontic treatment. Storey and Smith[54] (1952) introduced concepts of force, in which an optimum range of force values should be used to produce a maximum rate of movement of the canine without producing any discernible movement of the molar anchor unit and Begg[55] emphasized the advantages of differential force to produce the maximum rate of movement of teeth.

Factors such as malocclusion, type and extent of tooth movement (bodily/tipping), root angulation and length, missing teeth, intraoral/extraoral mechanics, patient compliance, crowding, overjet, extraction site, alveolar bone contour, interarch interdigitation, skeletal pattern, third molars, and pathology (i.e., ankylosis, periodontitis) affect anchor loss. According to Birte Melsen[56].anchor loss in all the three dimensions, can be reduced or avoided if mobility of the posterior unit before space closure is avoided. She further concludes that the best anchorage from a biological point of view is the periodontal ligament, where no change in the turnover occurred.

Accordingly, the movement of posteriors should be avoided or kept to a minimum, during retraction. But this task remains a major concern till date with rectangular wires. In order to allow easy sliding of the arch wire, during retraction, it is preferable to use a wire which is smooth and less stiffer and hence reduced friction. This can be produced with round wires. But, torque control during retraction of anteriors, is essential, and this is produced only by a rectangular wire in Pre-adjusted edgewise appliance. Thus, it is ideal to have both the characteristics of rectangular wire and round wire in the same archwire which allows smooth sliding of the archwire while maintaining the position of the molars.

To achieve this, the wire should be bidimensional. There are only few studies on bidimensional system of Orthodontics. In 1970, Schudy and Schudy[44] described the Bimetric System, a fixed orthodontic appliance incorporating two bracket slot sizes. Some years later, Gianelly[47] modified this system to develop the Bidimensional technique, using brackets with 018" vertical slots on the incisors and .022" vertical slots on the canines, premolars, and molars.Canon[45] described about Dual flex wires with different dimensions with different material in the anterior and posterior section. It combined two types of material titanol and stainless steel and depending on the anchorage requirement, the wires were interchanged. They were usually welded or soldered as they are made of two different materials, and so using them for sliding technique, becomes difficult and has flexibility in the anterior section. Even in those studies, the changes were made with, different bracket sizes for anterior and posterior, different sizes with the same dimension (dynaforce[48]) for anterior and posterior, different bracket material between anterior and posterior etc., are used each with its own advantages and disadvantages.

Dual Dimensional wire was introduced by A.wool[57] (1980), based on these bidimensional systems but control of molar position was a big hindrance for its development further. The unique feature of this wire is that the anterior portion is rectangular or square in cross section, which provides the necessary torque, during retraction. Conventional rectangular wires also produce effective torque control in the anteriors, during space closure. Generally it is assumed that as arch wire size increases so does the frictional resistance. The same is due as the geometry of the arch wire enlarges from round to square to rectangular. These sentiments are strongly supported by numerous studies (Andreasen and Quevedo[58], 1970; Drescher et al[59], 1 989; Angolkar et al, 1 990; Kapila et al[60], 1 990; Tanne et al, 1991 ;) Conventionally, the stiffer rectangular wires used during retraction resists sliding by the frictional forces occurring between the bracket and wire.

Dieter Drescheret[59] (1989) explained that guiding a tooth along an arch wire will results in a counteracting frictional force. They say that the effective force has to increase twofold to overcome the friction resulting in a hazardous overload of the anchorage units, with rectangular wires. So, to reduce friction clinically, some practitioners prefer the use of round wire, or they reduce rectangular wire in the buccal segments to a more rounded cross section. Round wires, of course, eliminate friction caused by active torque. Round wires generally produce less friction than rectangular wire when engaged in brackets out of alignment because of their greater flexibility. D.J. Michelberger[26] (2000) concluded that round stainless steel wires demonstrated lower coefficients of kinetic friction than the flat stainless steel wire surfaces.

Articolo and Kusy[61] found a one-hundred-percent increase in the resistance to sliding of various 0.021- x 0.025-inch archwires (stainless-steel, beta-titanium, and nickel-titanium alloys) in various 0.022-inch bracket-slots (stainless steel and ceramic) when the angulation was 3.0 degrees or greater. The data from their study indicated that, as angulation increased, the resistance to sliding from binding increased, adding to whatever friction might have been present in the absence of binding. The binding caused greater frictional resistance due to the stiffness of the wire. Though studies show that at binding angulations, round wire has more friction than rectangular wire, A Buzzoni R[27], (2011) showed in their study that round shaped wire will minimize binding .He explained that low friction system is based on the free flow between the wire and the bracket slot. To assure this free flow between the wire and the bracket binding should be kept to a minimum. They further say that to permit free flow the clinician will choose an initial wire of round shape with a very small diameter. This difference in size between the wire and the lumen of the bracket leaves an empty space that will minimize binding. A small round shape wire will also minimize binding at the entrance and exit of the bracket. The partial engagement minimizes tipping of the teeth. The combination of small round wires and no binding exerts lower forces on the periodontal membrane of the teeth in the system.

As this present study was conducted after leveling and alignment stage, binding of wire due to variations in the bracket positions was minimised. According to Tidy[22] (1998), in a well-aligned arch, the component of friction caused by active torque may also be greater for a closely fitting wire because of its greater torsional stiffness and the reduced play between wire and slot in rectangular wires. As both the wires in this study had rectangular or square cross section in the anterior segments, the torque expression in the anterior teeth was effective in this study. John C. Bennett[42] et al observed that archwire thinning was effective, but had been discarded because of reduced tooth control in the thinned areas. Selective torque application is more effective especially in the incisor regions.Loss of molar control was the constraining factor when this technique was followed.

But the advent of Skeletal anchorage, has ushered a new era of orthodontic treatment with minimal or nil anchor loss (Creekmore& Eklund[2] 1983). As the literature is flooded with the success stories of mini-implants, it becomes prudent to use them as direct anchorage in ideal cases. In this present study, as retraction force was given from the Dentos miniscrews, molars became free from being a posterior anchorage provider. Wendy L.osterman[62], has mentioned the usage of Dentos miniscrews in his successful practice.

Thiruvenkatachari B[34] et al., (2008) in his study observed that Canine retraction proceeds at a faster rate when titanium micro implants are used for anchorage. The amount of molar anchorage loss, in their study was measured from pterygoid vertical in the maxilla and sella-nasion perpendicular in the mandible. Mean anchorage losses were 1.60 mm in the maxilla and 1.70 mm in the mandible on the molar anchorage side; no anchorage loss occurred on the implant side. Madhur Upadhyay[37], observed that the mini-implants placed in the interdental bone between the maxillary first molar and second premolar proved to be efficient for intraoral anchorage reinforcements for en-masse retraction and intrusion of the maxillary anterior teeth.

Dixon[63] (2002) studied the rate of retraction between three commonly used. methods of force application-,elatomeric modules,elastic chain and NiTi springs.Elastics have a rapid decay property which necessitates frequent changes. The mean rate of space closure was 0.35 mm for active ligatures,0.58mm for power chain and 0.81 mm for NiTi coil springs.In this study,the retracting force was given by NiTi closed coil spring placed between the implant and the ‘s’ hook, attached to the distal of canine on either side of the upper arch.This allows the force to pass through ,almost near the center of resistance of the teeth and hence produce bodily tooth movement.

Basha[39] AG (2010) et al did a study to measure and compare the difference between rate of en-masse retraction with molar anchorage and mini-implant. Rate of retraction and anchor loss were measured by using pterygoid vertical in maxilla. They concluded that Mini-implants provided absolute anchorage in patients requiring maximum anterior retraction. Moschos A. Papadopoulos[40] (2010) also has used SN plane, Pt-v-6 and Ba-N plane as reference planes to compare molar movement. So, in this study, molar control measurements were made with the help of PtV, based on the above studies. The results were analyzed by SPSS software (Chicago) as it provides easy and reliable method of statistical analysis.

In the present study, the mean values for molar position with reference to pt V -6, in rectangular wire group at T0 were 23.87 mm and 23.75 mm at T1while the values were 24mm at T0 and 23.77mm at T1 in the DDW group. The mean change was 0.12mm and 0.22mm in the rectangular wire and DDW group respectively, but the changes were statistically insignificant.

The mean change was 1°in the rectangular wire group and 0.25° in the DDW group with respect to Ba-N plane. The mean change was 0.5°in the rectangular wire group and 0° in the DDW group with respect to S-N plane. These results shows that molar movement was more in the rectangular wire group which could be because of the torque expression or cinching effect.

There was no change in the mean molar position in the DDW group though, there was mesial movement of molar of about 1° in one patient and distal movement of 1°in another patient, and hence the mean change was nil, statistically. Overall, the changes in the molar position were statistically insignificant, which explains that the molar control was effective in both the wires with DDW being more effective.

The changes seen in the 2nd premolar was 0° and -0.06° respectively for rectangular wire and DDW group, both the changes being statistically insignificant. The changes in the canine position was clinically and statistically significant, with 6.75° and 8.5° in rectangular wire group and DDW group respectively, indicating more changes in DDW group.

According to the model analysis, on the right side, the mean molar transverse measurement was 22.62 mm at T0 and 22.75 mm at T1,while 22.75mm and 23 mm on the left side at T0and T1 respectively with rectangular wire.The mean transverse change on the right side was -0.12mm and -0.25 mm on the left side..While DDW group showed the mean transverse change -0.12mm on the right side and -0.12mm on the left side showing lesser change than the rectangular wire on the left side. This change could be due to mild tipping of molars buccally.

The mean transverse change in the 2nd premolar, on the right side was -0.37 mm and -0.25mm with rectangular group and DDW group respectively showing that the changes were minimal in DDW group.

The mean transverse changes in the canine, on the right side was -0.125 mm and 0 mm with rectangular group and DDW group respectively showing that the changes were more in rectangular group .

Rotational changes were measured with a tangent on the mesial and distal of 1st molar on either side with grid. The mean change in the distal tangent was -0.625 in the rectangular wire while -0.125 in the DDW group, showing lesser change in the DDW group. The same changes were observed on the mesial tangent also.

On the left side the mean change was 0.62 ° in the rectangular wire group while 0° change in DDW group both with the mesial and distal tangents .But the changes observed in both the groups were minor and were statistically insignificant.

The total amount of space closure was measured with the difference calculated between T0 and T1 values both with cephalometric and model analysis. Mesiodistal measurement between the margins of 2nd premolar and the canine was taken as the amount of space closure achieved. It was observed that the mean space closure obtained in rectangular wire group was 3.22mm while in DDW group it was 3.98mm.This indicates that DDW group achieved 0.76mm more amount of space closure within the same period, showing that DDW group has lesser resistance to sliding and hence producing more faster tooth movement, thereby reducing the retraction time.The results were highly significant (p-0.015). Similar results were observed when the horizontal distance was measured between the long axis of 2nd premolar and canine.The total space closure was 3.48mm and 3.9 mm respectively for rectangular group and DDW group.

Model analysis revealed the same observation.The mean change was 3.31 mm and 4.01 mm on the right side and 3.37mm and 4.07mm on the left side in the rectangular wire group and in the DDW group respectively. The results were statistically significant both for the right side (p-0.001) and for the left side (P-0.005). The changes found with model analysis was 0.62°and 0.12°with Rectangular wire and DDW groups respectively. The increased change in the rectangular wire group may be because of more protraction force or torque expressed with this wire whereas reduced value in DDW group may be explained by the round portion of the wire which produces minimum protraction force on the anchor teeth.

Though miniscrews play the role of direct anchor in both the groups, the rectangular wire is stiffer than the round portion of DDW .Hence, this property of DDW makes distal sliding easy, than the stiffer rectangular wire, which in turn, reduces the retraction period while position of molar is preserved. The study results reveals the amount of space closure was significant in both the groups as shown with cephalometric and model analysis The mean amount of space closure in the rectangular wire group was 3.23mm while it was 3.99 mm in the DDW group,showing 0.76 mm more retracton in Dual Dimensional Wire group,during the study period.

SUMMARY AND CONCLUSION

Successful closure of extraction space involves effective retraction of anteriors with good control of molars.

In sliding mechanics, the archwire travels along the brackets. Hence, to make the wire slide easily, the wire should have less stiffness, less friction, less binding and notching. This property of sliding easy is not possible with rectangular wires used for retraction as they are stiffer and produce more friction. The small round wires pillows easy sliding but with reduced control of molars due to the protracting forces acting on it.

To overcome this, the retracting forces are given from the miniscrews and hence effective molar control is achieved.

1. The amount of space closure is more in Dual dimensional wire than rectangular wire in the given study period. (0.7mm)
2. The space closure was faster with DDW than with rectangular wire.
3. There was a change in molar control of about 1° in the rectangular wire group but was statistically insignificant.
4. 0.22 mm change was observed in the molar position in the DDW group and 0.12mm in the rectangular wire group but the changes were statistically insignificant.
5. DDW can be used for effective space closure, when used with miniscrews.

CONCLUSION

In the age of low friction systems and microscrews, Dual Dimensional Wires offer a promising solution to, achieve faster rate of retraction compared to Conventional Rectangular wires, when microscrews are used as direct anchorage which provides good molar control as well. So, It is prudent to choose the wire which does not strain the anchors while moving the tooth at a faster rate.

BIBLIOGRAPHY

1. John c. Bennett, lds dorth richard p. Mclaughlin, dds .jco Controlled Space Closure with a Preadjusted Appliance System volume 24 : 1990
2. Creekmore TD, Eklund MK. The possibility of skeletal anchorage. J Clin Orthod. 1983 Apr;17(4):266-9..
3. Shingo Kuroda,a Yasuyo Sugawara,a Toru Deguchi,a Hee-Moon Kyung,b and Teruko Takano-Yamamotoc Okayama Clinical use of miniscrew implants as orthodontic anchorage: Success rates and postoperative discomfort. (Am J Orthod Dentofacial Orthop 2007; 131:9-15)
4. Giancotti, A. and Gianelly, A.A.: Three-dimensional control in extraction cases using a Bidimensional approach, World J.Orthod. 2:168-176, 2001 Progressive Orthodontics2007;8(1):144-55.
5. Ikegami T[1], Wong RW, Hägg U, Lee W, Hibino K The Hybrid Orthodontic Treatment System (HOTS). World J Orthod. 2010;11(2):168-79
6. Charles CR, Jones ML. Canine retraction with the edgewise appliance-some problems and solutions. Br J Orthod. 1982 Oct;9(4):194-202.
7. Ankara, Treatment Principles in Orthodontics, ed 3: Ankara Univ, 1990.
8. 1.J.A.Von Fraunhofer and B.E.Johnson Angle orthodontist vol.63 no.21993
9. Kusy RP, Whitley JQ. Resistance to sliding of orthodontic appliances in the dry and wet states: influence of archwire alloy, interbracket distance, and bracket engagement. J Biomed Mater Res. 2000 Dec 15;52(4):797-811.

10. Joon-No Rhee, Youn-Sic Chun, and Joon Row, A comparison between friction and frictionless mechanics with a new typodont simulation system (Am J Orthod Dentofacial Orthop 2001;119:292-9)

11. Tominaga JY, Tanaka M, Koga Y, Gonzales C, Kobayashi M, Yoshida N. Optimal loading conditions for controlled movement of anterior teeth in sliding mechanics. Angle Orthod. 2009 Nov;79(6):1102-7.

12. Heo W, Nahm DS, Baek SH. En masse retraction and two-step retraction of maxillary anterior teeth in adult Class I women. A comparison of anchorage loss. Angle Orthod. 2007 Nov;77(6):973-8.

13. Barlow M, Kula K. Factors influencing efficiency of sliding mechanics to close extraction space: a systematic review. Orthod Craniofac Res. 2008 May;11(2):65-73. 1601-6343.2008.00421.

14. Thiruvenkatachari B, Ammayappan P, Kandaswamy R. Comparison of rate of canine retraction with conventional molar anchorage and titanium implant anchorage. Am J Orthod Dentofacial Orthop. 2008 Jul;134(1): 30-5.

15. Kojima Y, Fukui H. Numeric simulations of en-masse space closure with sliding mechanics. Am J Orthod Dentofacial Orthop. 2010 Dec;138(6):702.e1-6; discussion 702-4.2010.06.015.

16. Xu TM, Zhang X, Oh HS, Boyd RL, Korn EL, Baumrind S. Randomized clinical trial comparing control of maxillary anchorage with 2 retraction techniques. Am J Orthod Dentofacial Orthop. 2010 Nov;138(5):544.e1-9;

17. Felemban NH, Al-Sulaimani FF, Murshid ZA, Hassan AH-En masse retraction versus two-step retraction of anterior teeth in extraction

treatment of bimaxillary protrusion. J Orthod Sci. 2013 Jan;2(1):28-37. 0203.110330

18. Bednar JR, Gruendeman GW, Sandrik JL. A comparative study of frictional forces between orthodontic brackets and arch wires.Am J Orthod Dentofacial Orthop. 1991 Dec;100(6):513-22.
19. Husain N, Kumar A. Frictional resistance between orthodontic brackets and archwire: an in vitro study. J Contemp Dent Pract. 2011 Mar 1;12(2):91-9.
20. Rajesh M, Kishore MS, Shetty KS . Comparison of anchorage loss following initial leveling and aligning using ROTH and MBT Prescription – A clinical prospective study J Int Oral Health 2014;6(2):16-21.
21. Frank CA, Nikolai RJ. A comparative study of frictional resistances between orthodontic bracket and arch wire. Am J Orthod. 1980 Dec;78(6):593-609.
22. Tidy Frictional forces in fixed appliances - 1998 AJO-DO, Volume 1989 Sep (249 - 254):
23. Drescher D ,Bourauel C, Schumacher HA -Frictional forces between bracket and arch wire Am J Orthod Dentofacial Orthop. 1989 Nov;96(5):397-404
24. Kapila S, Angolkar PV, Duncanson MG Jr, Nanda RS. Evaluation of friction between edgewise stainless steel brackets and orthodontic wires of four alloys. Am J Orthod Dentofacial Orthop. 1990 Aug;98(2):117-26.
25. Tselepis M, Brockhurst P, West VC. The dynamic frictional resistance between orthodontic brackets and arch wires. Am J Orthod Dentofacial 63.vixonOrthop. 1994 Aug;106(2):131-8.

26. Michelberger DJ, Eadie RL, Faulkner MG, Glover KE, Prasad NG, Major PW. The friction and wear patterns of orthodontic brackets and archwires in the dry state.Am J Orthod Dentofacial Orthop. 2000 Dec;118(6):662-74

27. A Buzzoni R, Elias CN, Fernandes DJ, Miguel JAM -Dental Press J Orthod 37 2011 July-Aug;16(4):35

28. Dholakia KD. Friction and anchorage loading revisited. Orthodontics (Chic.). 2012;13(1):200-9.

29. Costa A, Raffainl M, Melsen B Miniscrews as orthodontic anchorage: a preliminary report Int J Adult Orthodon Orthognath Surg. 1998;13(3): 201-9.

30. Park HS A new protocol of the sliding mechanics with micro-implant anchorage (M.I.A.). Korean J Orthod. 2000 Dec;30(6):677-685.

31. Hyo-Sang Park, Tae-Geon Kwon, (2004) Sliding Mechanics with Microscrew Implant Anchorage (Angle Orthod 2004;74:703–710.)

32. Eric J. W. Liou, ,a Betty C. J. Pai, and James C. Y. Lin, (2004) Do miniscrews remain stationary under orthodontic forces?, Taipei, Taiwan (Am J Orthod Dentofacial Orthop 2004;126:42-7).

33. Aldo Carano, Stefano Velo, Paola Leone, Giuseppe Siciliani -Clinical Applications of the Miniscrew Anchorage System volume xxxix number 1 JCO 2005.

34. Badri Thiruvenkatachari,a A. Pavithranand,b K. Rajasigamani,c and Hee Moon Kyungd and Daegu, Comparison and measurement of the amount of anchorage loss of the molars with and without the use of implant anchorage during canine retraction.(*Am J Orthod Dentofacial Orthop.* 2006;129:551–554).

35. Hyo-Sang Park,a Seong-Hwa Jeong,b and Oh-Won Kwonc -Factors affecting the clinical success of screw implants used as orthodontic anchorage.Hyo-Sang Park,a Seong-Hwa Jeong,b and Oh-Won Kwonc(Am J Orthod Dentofacial Orthop 2006;130:18-25).

36. Neal D. Kravitza and Budi Kusnotob(Risks and complications of orthodontic miniscrews (Am J Orthod Dentofacial Orthop 2007;131:00).

37. Madhur Upadhyay,a Sumit Yadav,b and Sameer Patilc -Mini-implant anchorage for en-masse retraction of maxillary anterior teeth: A clinical cephalometric study- (Am J Orthod Dentofacial Orthop 2008;134:803-10).

38. Shingo Kuroda,a Kazuyo Yamada,b Toru Deguchi,c Hee-Moon Kyung,d and Teruko Takano-Yamamoto-Class II malocclusion treated with Miniscrew anchorage: Comparison with traditional orthodontic mechanics outcomes e (Am J Orthod Dentofacial Orthop 2009;135:302-9).

39. Basha AG, Shantaraj R, Mogegowda SB. -Comparative study between conventional en-masse retraction (sliding mechanics) and en-masse retraction using orthodontic micro implant. Implant Dent. 2010 Apr;19(2):128-36 .

40. Papadopoulos MA, Papageorgiou SN, Zogakis IP. Papadopoulos MA, Papageorgiou SN, Zogakis IP. Clinical effectiveness of orthodontic miniscrew implants: a meta-analysis. J Dent Res. 2011 Aug;90(8):969-76.

41. Jambi S, Walsh T, Sandler J, Benson PE, Skeggs RM, O'Brien KD. Reinforcement of anchorage during orthodontic brace treatment with implants or other surgical methods. Cochrane Database Syst Rev. 2014 Aug 19;8:CD005098.

42. John C. Bennett, Richard P. Mclaughlin ,Controlled Space Closure with a Preadjusted Appliance System Jco volume 24 : Number 04 : Pages (251-260). 1990.

43. Schudy, F.F. and Schudy, G.F.: The Bimetric system, Am. J. Orthod. 67:57-91, 1975.

44. Cannon JL. Dual flex archwires. J Clin Orthod 1985:49:47-55

45. José L. Zuriarrain, José M. Echeverría, Javier del Valle, William J. Thompson, Our experience in combining mechanics Special Article (Am J Orthod Dentofacial Orthop1996,Dec.110(6):575-1.

46. Greco M, Giancotti A Sliding mechanics in extraction cases with a bidimensional approach.Progressive Orthodontics2007;8(1):144-55.

47. Giancotti A' Greco M Modified sliding mechanics in extraction cases with a bidimensional approach. 2010 Società Italiana di Ortodonzia SIDO.

48. Daniele Cantarella, Luca Lombardo, and Giuseppe Siciliani Ann Stomatol (Roma). The dynforce archwire 2013 Apr-Jun; 4(2): 204–211. ID:

49. Badri Thiruvenkatachari,a A. Pavithranand,b K. Rajasigamani,c and Hee Moon Kyungd Comparison and measurement of the amount of anchorage loss of the molars with and without the use of implant anchorage during canine retraction (Am J Orthod Dentofacial Orthop 2006;129:551-4).

50. Jacobson PA, Sadowsky L. Superimposition of cephalometric radiographs. Chicago: Quintessence; 1995. p. 165-74.

51. Tweed CH. The application of the principles of the Edgewise arch in the treatment of malocclusions. Angle Orthod 1941;11:12–67.

52. Holdaway RA. Bracket angulation as applied to the Edgewise appliance. Angle Orthod. 1952;22:227–236.

53. Merrifield, LL. The Sequential Directional Force Technique, in New Vistas in Orthodontics. Philadelphia, Pa: Lea & Febiger; 1985:184–208.

54. Storey E, Smith R. Force in orthodontics and its relation to tooth movement. Australias Dent J. 1952;56:11–18.

55. Begg PR. Differential force in orthodontic treatment. Am J Orthod. 1956;42:481–510.

56. Birte Melson Interview on Adult Orthodontic Treatment volume XL number 12 JCO 2006.

57. Wool A. D-D Arches S & E Appliance Technique. Wyomissing, Pennsylvania: Wonder Wire, 1991:1–30.

58. Andreasen GF, and Quevedo FR. Evaluation of functional forces in the 0.022 x 0.028 edgewise bracket in vitro. J Biomechanics 1970; 3: 1 5 1 - 160.

59. Drescher D, Bourauel C, and Schurnacher HA. Fnctional forces between bracket and arch wire. Am J Orthod Dentofac Orthop 1989; 96: 397-404.

60. Angolkar PD, Kapila S, Duncanson MG, and Nanda RS. Evaluation of fiction between ceramic brackets and orthodontic wires of four alloys. Am J Orthod Dentofac Orthop 1990; 98: 499-506.

61. Articolo LC, and Kusy RP. Influence of angulation on the resistance to sliding in fixed appliances. Am J Orthod Dentofac Orthop 1999; 1 1 *5:* 39-5 1.

62. Wendy L.Osterman An interview.jco vol.42 num-09-2008.

63. Dixon V.,Read Mjf,O'brien,Worthington HV.,Mandall NA-A Random Clinical trial to compare three methods of orthodontic space closure Am J Dentofac Orthop 2002:29(1):31-6.

Annexure - 1

தகவல் அறிக்கை படிவம்

அன்புடையீர்

வணக்கம் .தமிழ்நாடு அரசு பல் மருத்துவ கல்லூரியின் பல் சீரமைப்பு துறை சார்பாக ஒரு ஆய்வு நடத்தபடுகிறது.

இந்த ஆய்வு பல்சீரமைப்புக்காக பற்களின் மேல் ஓட்டப்பட்டு செயல்படும் கருவி மற்றும் மினி ஸ்குரு உதயுடன் பற்களை பின்னோக்கி நகர்த்துவதில் இருபரிணாம கம்பிகளுக்கும் சாதாரணமாக பயன்படுத்தப்படும் கம்பிகளுக்கும் இடையேயான வேறுபாடுகளை கண்டறிவதற்காக நடத்தபடுகிறது.

தேர்ந்தேடுக்கபடும் நோயாளிகளின் விபரங்கள் இரகசியமாக வைக்கபடும்.

இந்த ஆய்வில் கலந்துகொள்வதற்கும் மற்றும் விலகி கொள்வதற்கும் சுதந்திரம் அளிக்கப்படுகிறது.
தங்கள் குழந்தை\தாங்கள் இந்த ஆய்வில் பங்கேற்க சம்மதம் எனில்,உடன்இணைத்துள்ள ஒப்புதல் படிவத்தில் கையொப்பமிடவும்.

முதன்மை ஆய்வாளர்
தமிழ்நாடு அரசு பல் மருத்துவ கல்லூரி
சென்னை-600 003

Annexure - 2

INFORMATION SHEET

• We are conducting a study on "***A Comparative study of rate of retraction and molar control between Dual Dimensional wires and rectangular wires during retraction, using miniscrews"***

A Comparative study of rate of retraction and molar control between Dual Dimensional wires and rectangular wires during retraction, using miniscrews "• The privacy of the subjects in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

• Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

• The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of investigator   Signature of parent/ guardian

Date

Annexure - 3

ஆராய்ச்சி ஒப்புதல் படிவம்

பல் மற்றும் முகத்தாடை சீரமைப்பு பிரிவு,
தமிழ்நாடு அரசு பல் மருத்துவக்கல்லூரி மற்றும் மருத்துவமனை,
சென்னை-600 003.

ஆராய்ச்சியின் தலைப்பு

மினி ஸ்குரூ உதவியுடன் பற்களை பின்னோக்கி நகர்த்துவதில் இரு பரிணாம கம்பிகளின் மருத்துவப் பயன்பாடுகளை கண்டறியும் ஆய்வு

ஆராய்ச்சியாளரின் பெயர் : **மரு.சங்கீதா எம்.ஜி.**
முதுநிலை மருத்துவ மாணவி,
பல் மற்றும் முகத்தாடை சீரமைப்பு பிரிவு,
தமிழ்நாடு அரசு பல் மருத்துவக் கல்லூரி மற்றும் மருத்துவமனை,
சென்னை-3.

ஆராய்ச்சியின் நோக்கம் : மினி ஸ்குரூ உதவியுடன் பற்களை பின்னோக்கி நகர்த்துவதில் இரு பரிணாம கம்பிகளின் மருத்துவப் பயன்பாடுகளை கண்டறிதல்

பங்கேற்பாளர் பெயர் : **தேதி:**

வயது / பாலினம் : **ஆராய்ச்சி சேர்க்கை எண்:**

உள்/ புற நோயாளி எண் :

என் சுய நினைவுடனும் மற்றும் முழு சுதந்திரத்துடனும் இந்த மருத்துவ ஆராய்ச்சியில் சேர்ந்துகொள்ள ஒப்புதல் அளிக்கிறேன்.

கீழ்காணும் நிபந்தனைகளுக்கு நான் ஒப்புதல் அளிக்கிறேன். இந்த ஆராய்ச்சியின் நோக்கமும், செயல்படுத்தும் முறைகளும் பல் மருத்துவரால் எனக்கு தெளிவாக விளக்கப்பட்டது.

இந்த ஆராயச்சியில் எனது பற்களை ஒழுங்கான முறையில் வரிசைப்படுத்திய பின் மறத்துப்போகும் ஊசியானது எனது மேல் தாடையில் போடப்படும். அதன்பின்பு மினிஸ்குரு எனது மேல் தாடையில் பொருத்தப்படும். பின்பு இரு பரிணாம கம்பிகளின் மூலம் எனது பற்கள் பின்னோக்கி நகர்த்தப்படும். இந்த நிகழ்வானது எனது பல்சீரமைப்பு சிகிச்சையின் ஓர் அங்கமாகும்.

இந்த ஆய்வானது நான்கு மாதங்கள் மேற்கொள்ளப்படும். பின்பு எனது பற்கள் வழக்கமான முறைப்படி சிகிச்சை செய்து முடிக்கப்படும் என்பதை பல் மருத்துவரால் எனக்கு தெளிவாக விளக்கப்பட்டது.

இந்த ஆய்விற்காக எந்த தொகையும் என்னிடம் வசூலிக்கப்பட்மாட்டாது என்பதை அறிகிறேன்.

இந்த ஆய்வின்போது எனது உடல்நலம் பாதிக்கப்பட்டாலோ அல்லது வழக்கத்திற்கு மாறாக ஏதேனும் நோய்குறிகள் தென்பட்டாலோ அதனை உடனடியாக பல் மருத்துவரிடம் தெரிவிக்க சம்மதிக்கிறேன்.

என் மருத்துவ குறிப்பேடுகளை இந்த ஆராய்ச்சியில் பயன்படுத்திக்கொள்ள சம்மதிக்கிறேன். இந்த ஆராய்ச்சி மையமும், ஆராய்ச்சியாளரும் என்னுடைய விவரங்கள் அனைத்தையும் இரகசியமாக வைப்பதாக அறிகிறேன்.

பங்கேற்பாளரின் பெயர்	கையொப்பம்	தேதி
பங்கேற்பாளரின் பெற்றோர் பெயர்	கையொப்பம்	தேதி
ஆராய்ச்சியாளரின் பெயர்	கையொப்பம்	தேதி

Annexure - 4

PARENT'S / PATIENT'S INFORMED CONSENT FORM

Title of the study: "***A Comparative study of rate of retraction and molar control between Dual Dimensional wires and rectangular wires during retraction, using miniscrews"***

Name of the Participant:

Name of the Principal Investigator:Dr.Sangeetha.M.G., Postgraduate student, Dept of orthodontics., Tamil nadu govt. Dental college & Hospital, Chennai.

Name of the Guide: Prof. Dr. Sridhar premkumar M.D.S

Name of the Institution: Tamil nadu govt. Dental college & Hospital , Chennai.

Documentation of the informed consent

I ______________________________ have read the information in this form (or it has been read to me). I was free to ask any questions and they have been answered. I am over 18 years of age and, exercising my free power of choice, hereby give my consent for me/my ward to be included
as a participant in the above said study.

1. I have read and understood this consent form and the information provided to me.
2. I have had the consent document explained to me.
3. I have been explained about the nature of the study that distalization of upper molar to create space is the first step followed by the regular second step of overjet reduction and establishment of stable ideal occlusion.
4. My rights and responsibilities have been explained to me by the investigator.
5. I agree to co-operate with the investigator and I will inform him/her immediately if my ward suffers unusual symptoms.
6. My ward has not participated in any research study within the past _________month(s).

7. I am aware of the fact that my ward can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital.
8. I hereby give permission to the investigators to release the information obtained from my ward as result of participation in this study to the sponsors, regulatory authorities, Govt. agencies,
and IEC. I understand that they are publicly presented.
9. My/ My ward's identity will be kept confidential if the data are publicly presented
10. I am aware that if I have any question during this study, I should contact at one of the addresses listed above. By signing this consent form I attest that the information given in this document has been clearly explained to me and apparently understood by me,
I will be given a copy of this consent document.

Parent's/guardian's Initials: __________

Name and signature / thumb impression of the participant (or legal representative if participant incompetent)

_______________ _________________

____

Name Signature Date

Name and Signature of impartial witness (required for illiterate patients):

_______________ _________________

____

Name Signature Date

Address and contact number of the impartial witness:

Name and Signature of the investigator or his representative obtaining consent:

_______________ _________________

____

Name Signature Date

Annexure - 5

ஊடுகதிர் எடுப்பதற்கான ஒப்புதல் படிவம்

பல் மற்றும் முகத்தாடை சீரமைப்பு பிரிவு,
தமிழ்நாடு அரசு பல் மருத்துவக்கல்லூரி மற்றும் மருத்துவமனை,
சென்னை-600 003.

ஆராய்ச்சியாளரின் பெயர் : மரு.சங்கீதா எம்.ஜி.
முதுநிலை மருத்துவ மாணவி,
பல் மற்றும் முகத்தாடை சீரமைப்பு பிரிவு,
தமிழ்நாடு அரசு பல் மருத்துவக் கல்லூரி மற்றும் மருத்துவமனை,
சென்னை-3.

கீழ்காணும் எனது கையொப்பம் இந்த ஆராய்ச்சியில் பங்கேற்பதற்காக தேவைப்படும் **ஊடுகதிர்** படங்களை எடுப்பதற்காக நான் முழு மனதுடனும் சுய நினைவுடனும் **ஒப்புக்கொள்வதற்கான** சான்றாகும். ஊடுகதிர்கள் பற்றிய விபரங்கள் அனைத்தும் எனக்கு தெளிவாக விளக்கப்பட்டது.

பங்கேற்பாளரின் பெயர்	கையொப்பம்	தேதி
பங்கேற்பாளரின் பெற்றோர் பெயர்	கையொப்பம்	தேதி
ஆராய்ச்சியாளரின் பெயர்	கையொப்பம்	தேதி

Annexure - 6

DEPARTMENT OF ORTHODONTICS AND DENTOFACIAL ORTHOPAEDICS
TAMILNADU GOVT. DENTAL COLLEGE AND HOSPITAL
CHENNAI-3
CONSENT FOR RADIOGRAPHIC EXAMINATION

INVESTIGATOR
SANGEETHA.M.G
II YR PG
Department of Orthodontics and Dentofacial Orthopaedics
Tamilnadu govt. Dental College and Hospital

My signatures below acknowledges that i have voluntarily agreed to participate in this radiographic examination and i will be exposed to a minimal amount of radiation.

Signature of participant Date

Name of participant

Investigator’s Signature Date

Annexure - 7

INSTITUTIONAL ETHICAL COMMITTEE
Tamil Nadu Government Dental College and Hospital, Chennai - 3
Telephone No. 044 2534 0343
Fax 044 2530 0681

Ref.No.0430/ DE/ 2010 Date: 29.04.2014

Title of the work: "A Comparative study of rate of retraction and molar control, between Dual Dimensional wires and rectangular wires during retraction, using miniscrews"

Principal investigator: **Dr.M.G.Sangeetha,**
II Year MDS

Department : Orthodontics & Dentofacial Orthopedics,
Tamil Nadu Government Dental College and Hospital, Chennai - 3

The request for an approval from the Institutional Ethical Committee (IEC) considered on the IEC meeting held on **28.04.2014** at the Principal's Chambers Tamil Nadu Government Dental College and Hospital, Chennai – 3

"Advised to proceed with the study"

The Members of the Committee, the secretary and the Chairman are pleased to approve the proposed work mentioned above , submitted by the principal investigator.

The principal investigator and their team are directed to adhere the guidelines given below:

1 .You should get detailed informed consent from the patients / participants and maintain confidentiality

2. you should carry out the work without detrimental to regular activities as well as without extra expenditure to the Institution or Government.

3 You should inform the IEC in case of any change of study procedure , site and investigation or guide.

4. You should not deviate from the area of work for which you have applied for ethical clearance

5. You should inform the IEC immediately in case of any adverse events or serious adverse reactions. You should abide to the rules and regulations of the institution (s)

6. You should complete the work within the specific period and if any extension of time is required, you should apply for permission again and do the work.

7 .You should submit the summary of the work to the ethical committee on completion of the work.

8. You should not claim funds from the Institution while doing the work or on completion.

9.You should understand that the members of IEC have the right to monitor the work with prior intimation

10. Your work should be carried out under the direct supervision of your Guide / Professor.

29/04/14.
SECRETARY CHAIRMAN

Annexure – 8

Master Charts

PATIENT	AGE	SEX	MES-DIS	LONG AXIS	PTV-6	ANGSN-6	BA-N-6	BAN-M	BAN-PM	BA N-C	SPACE13-14	23-24	I.P.-6 RT	I.P -5 RT	I.P-3 RT	I.P.-6 LT	I.P -5 LT	I.P-3LT	MID C RT	MID C LT	MID-PM - RT	MID PM LT	MID M RT	MID M LT	M-ANG-RT	M-ANG-RT	M-ANG-LT	M ANG LT
A1	22	M	4	9.5	24	76	100	121	111	102	4	4	23	13	3	23	13	3	18	19	20	21	23	23	20	45	20	45
A2	20	M	6.5	11.4	23	76	102	119	109	99	6	6	23	13	3.5	22.9	13	3.5	19	19	20	21	22	23	22	40	22	40
A3	21	M	5.8	11	23	75	103	120	109	98	5	5.2	24	13.3	3	24	13	3	18	18	21	22	24	23	25	45	25	45
A4	18	F	6	11.2	24	78	101	120	107	97	6	5.8	23	12.5	2.9	23	12	2.8	18	18	22	22	23	23	25	45	25	45
A5	18	F	6.4	12	24	79	102	119	99	99	6	5.8	22.5	13	3	22.5	13	3	19	19	20	21	22	23	20	40	20	40
A6	20	M	6	11	26	80	98	114	108	96	5.8	6	22	12	2.8	22.1	12	2.8	19	18	21	21	23	23	25	45	25	45
A7	22	F	5	10	24	78	101	101	118	100	5	5	23.5	12	3.2	23.5	12	3.1	18	18	20	20	22	22	20	40	22	42
A8	19	F	5.5	10	23	76	107	102	104	97	5.4	5	24	12	3	24	12	3	18	18	20	20	22	22	20	40	20	40
MEAN	**20**		**5.65**	**10.7625**	**23.875**	**77.25**	**101.75**	**114.5**	**108.125**	**98.5**	**5.4**	**5.35**	**23.125**	**12.6**	**3.05**	**23.125**	**12.5**	**3.025**	**18.375**	**18.375**	**20.5**	**21**	**22.625**	**22.75**	**22.125**	**42.5**	**22.375**	**42.75**
A1	22	M	1.5	6	24	77	101	120	111	113	1.4	1.5	22.5	13	4	22	13	4	18	18	20	21	23	23	20	45	20	45
A2	20	M	3	8	24	76	102	116	109	105	2	2	23	13	3.5	22.9	13	3.5	19	19	21	21	22	24	23	41	21	39
A3	21	M	2	7	25	73	101	118	108	103	1.8	2	23	13.3	3.4	23	13.3	3.4	18	19	21	22	24	23	26	46	24	44
A4	18	F	3.5	8.6	20	77	97	119	114	101	3	2.5	22.6	12.5	3	23	12	2.8	18	18	22	21	23	23	25	45	25	45
A5	18	F	3	7	24	78	100	107	98	106	2.7	2.8	22.5	13	3.2	22.5	13	3	19	19	21	21	22	23	21	41	19	39
A6	20	M	2.6	7.8	26	80	98	114	108	104	2.3	2.3	22	12	3	22	12	2.8	18	18	21	21	23	23	25	45	27	47
A7	22	F	1.8	6.8	23	78	101	102	114	105	1.5	1.5	23.5	12	3.2	23.5	12	3	18	18	21	21	23	23	20	40	20	40
A8	19	F	2	7	24	75	106	101	103	105	2	1.2	23.6	12	3.2	24	12	3	18	18	20	19	22	22	22	42	18	38
MEAN	**20**		**2.425**	**7.275**	**23.75**	**76.75**	**100.75**	**112.125**	**108.125**	**105.25**	**2.0875**	**1.975**	**22.8375**	**12.6**	**3.3125**	**22.8625**	**12.5375**	**3.1875**	**18.25**	**18.375**	**20.875**	**20.875**	**22.75**	**23**	**22.75**	**43.125**	**21.75**	**42.125**

PATIENT	AGE	SEX	MES-DIS	LONG AXIS	PTV-6	SN-6	BA-N-6	BAN-PM	BA N-C	SPACE13 -15	23-25	I.P.-6 RT	I.P -5 RT	I.P-3 RT	I.P.-6 LT	I.P -5 LT	I.P-3 LT	MID C RT	MID C LT	MID-PM - RT	MID PM LT	MID M RT	MID M LT	M ANG RT	M ANG RT	M-ANG- LT	M ANG LT
B1	19	F	6.5	12.3	24	77	96	108	96	6.3	6	22.5	13	3	22	13	3	18	19	20	21	23	23	25	45	25	45
B2	18	F	6	11	26	78	101	117	104	5	6	23	13	3.5	23	13	3.5	19	19	21	21	22	23	22	40	22	40
B3	23	M	6.5	13.2	23	67	86	110	100	6.5	6.4	23	13.3	3	23	13.2	3	18	18	20	21	23	23	25	45	25	45
B4	22	F	5	11.7	24	76	96	119	109	5	4.9	22.6	12.5	2.9	22.6	12	2.9	18	18	22	22	23	23	25	45	25	45
B5	19	M	6.2	12	24	78	93	117	108	6.2	6.3	22.5	13	3	22	13	3.1	19	19	20	21	22	23	20	40	20	40
B6	18	F	6	12.5	26	69	100	108	109	6	6	22	12	2.8	22	12	2.8	18	19	21	20	23	23	25	45	25	45
B7	21	M	6.5	13	20	77	97	114	94	6.4	6.3	23.5	12	3.2	23.4	12	3.1	18	18	20	20	22	22	20	40	22	42
B8	20	M	5	11	25	80	89	109	98	5.4	5.3	23.6	12	3	23.6	12	3	18	18	20	20	22	22	20	40	25	45
MEAN	**20**	**M=F**	**5.9625**	**12.0875**	**24**	**75.25**	**94.75**	**112.75**	**102.25**	**5.85**	**5.9**	**22.8375**	**12.6**	**3.05**	**22.7**	**12.525**	**3.05**	**18.25**	**18.5**	**20.5**	**20.75**	**22.5**	**22.75**	**22.75**	**42.5**	**23.625**	**43.375**
B1	19	F	2.2	11.5	24	77	96	108	108	2	2	22.5	13	3.2	22	13	4	18	18	20	21	23	23	25	45	25	45
B2	18	F	1	6	26	78	101	117	113	1	1.3	23	13	3.5	23	13	3.7	19	19	21	21	22	23	22	40	22	40
B3	23	M	2.8	8.8	22	67	86	111	108	2.3	2.1	23	13.3	3	23	13.2	3.2	18	18	21	22	24	23	25	45	25	45
B4	22	F	1	6.2	24	75	95	118	118	0.8	1	22	12	3.2	22	12.2	2.9	18	18	22	21	23	23	26	46	25	45
B5	19	M	2.8	9	24	78	93	117	118	2.5	2.1	22.5	13	3.1	22	13	3.1	19	19	20	21	22	23	20	40	20	40
B6	18	F	2.1	8	25	70	101	109.5	117	2.2	2.2	21.8	12.2	2.9	21.8	12.2	2.8	18	18	21	20	23	23	25	45	25	45
B7	21	M	2	8	20	77	97	114	101	2.1	2.1	23.5	12	3.2	23.4	12	3	18	18	21	21	22	23	20	40	22	42
B8	20	M	1.9	8	25.2	80	89	108	103	1.8	1.8	23.6	12	3	23.6	12	3	18	18	20	19	22	22	20	40	25	45
MEAN	**20**	**M=F**	**1.975**	**8.1875**	**23.775**	**75.25**	**94.75**	**112.8125**	**110.75**	**1.8375**	**1.825**	**22.7375**	**12.5625**	**3.1375**	**22.6**	**12.575**	**3.2125**	**18.25**	**18.25**	**20.75**	**20.75**	**22.625**	**22.875**	**22.875**	**42.625**	**23.625**	**43.375**